DRAFT ST. REGIS WATERSHED TOTAL MAXIMUM DAILY LOADS AND FRAMEWORK WATER QUALITY RESTORATION ASSESSMENT

Sediment and Temperature TMDLs

Public Comment Draft
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EXECUTIVE SUMMARY

The St. Regis watershed is located entirely in Mineral County, Montana, and encompasses 365 square miles (233,443 acres) of largely federally owned lands (**Figure 2-1**). Tributaries of the St. Regis River included in this document are Twelvemile, Silver, Big, Ward, Deer, Little Joe, North Fork Little Joe, and Savenac Creeks, along with several smaller tributaries. The St. Regis River has its headwaters at St. Regis Lakes approximately 3 miles southwest of Lookout Pass on Interstate 90 (I-90) near the Montana-Idaho border. The river flows in a generally southeasterly direction for nearly 39 miles before entering the Clark Fork River at St. Regis, Montana. The elevation at St. Regis Lakes is 5,590 feet, and the river joins the Clark Fork at an elevation of 2,640 feet. The highest point in the watershed is 7,297 feet along the basin's western boundary in the Bitterroot Mountains.

The Clean Water Act requires the development of TMDLs that will provide conditions that can support all identified uses. This document combines a generalized watershed restoration strategy along with creation of TMDLs. The designated water uses include drinking, culinary and food processing after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply. Clean Water Act objectives include restoration and maintenance for all of these uses. In the St. Regis watershed the most sensitive uses are the fishery and aquatic life.

A TMDL is a pollutant budget identifying the maximum amount of a particular pollutant that a water body can assimilate without causing applicable water quality standards to be exceeded. Section 303 of the Federal Clean Water Act and the Montana Water Quality Act (Section 75-5-703) require development of TMDLs for impaired water bodies that do not meet Montana water quality standards. Section 303(d) also requires identification of impaired water bodies on a list, referred to as the 303(d) list. This 303(d) list is updated every two years and submitted to the U.S. Environmental Protection Agency (U.S. EPA) by the Montana Department of Environmental Quality (MDEQ).

The whole length of the St. Regis River, from near Lookout Pass to the confluence with the Clark Fork River, is identified as impaired on Montana's 303(d) list. In addition, 7 tributaries were listed in 1996 as threatened waterbodies, 4 of which are still considered impaired on Montana's current 303(d) list. This document focuses on sediment, temperature and fishery habitat impairments in the St. Regis River watershed. TMDLs are provided for St. Regis River, Big, Little Joe, North Fork Little Joe and Twelvemile Creeks.

Source assessments identify transportation, timber harvest, sources of bank erosion, and suburban activities as the primary sources of human caused pollutants in the St. Regis Watershed. Restoration strategies for the St. Regis River TPA focus on implementing road management BMPs, timber harvest BMPs, providing stream corridor shade and sediment buffers, suburban development BMPs, and other land, soil, and water conservation practices that relate to near stream channel and vegetation conditions.

The restoration process identified in this document is voluntary, cannot divest water rights or private property rights, and does not financially obligate identified stakeholders unless such measures are already a requirement under existing Federal, State, or Local regulations. Any recommendations for NPDES point sources provided in this document will be used for managing the point source in the future.

Restoration strategies identified in this document are intended to balance the varying uses of water while adhering to Montana's water quality and water use laws. This document should be considered dynamic, by providing an "adaptive management strategy" approach to restore water quality in the St. Regis River Watershed. This water quality plan is intended to identify the knowledge we have at present and to identify a future path for water quality restoration. As more knowledge is gained through the restoration process and future monitoring, this plan may change to accommodate new science and information. Montana's water quality law provides an avenue for using the adaptive management process by providing for future TMDL reviews.

The state is required to support a voluntary program of reasonable land, soil and water conservation practices. MDEQ's approach to this program recognizes that the cumulative impacts from many nonpoint source activities are best addressed via voluntary measures with MDEQ and/or other agency or other forms of professional assistance. This often applies to agricultural situations or small landowner activities along or near streams. The State's voluntary program does not cover all nonpoint source activities since there are local, state and/or federal regulations that apply to certain nonpoint source activities within Montana. Examples where a non-voluntary approach is applicable due to existing regulations include but are not limited to streamside management zone requirements for timber production, minimum septic design and location requirements, local zoning requirements for riparian or streambank protection, and compliance with 310 Law.

The document structure provides specific sections that address TMDL components and watershed restoration. Sections 1.0 through 4.0 provide background information about the St. Regis River watershed, Montana's water quality standards, and Montana's 303(d) listings. Sections 4.0 and 5.0 provide TMDL targets and impairment status reports by water body. Sections 6.0 (sediment) and 7.0 (temperature) review specific pollutant source assessments, TMDLs and allocations. Generalized restoration strategy and follow up monitoring approach are provided in sections 8.0 and 9.0. Section 10.0 is a review of stakeholder and public involvement during the TMDL process. Many of the detailed technical analyses are provided in appendices. **Table E-1** provides a very general summary of the water quality restoration plan and TMDL contents.

Table E-1 provides a summary of the water quality restoration plan and TMDL components discussed in this document.

Table E-1. Water Quality Plan and TMDL Summary Information.

Impaired Water Body Summary	• Of the 8 water bodies originally listed on the 1996 303(d) List as threatened for water quality impairment, 5 water bodies are considered impaired and have TMDLs prepared in this document. Pollutants addressed by TMDLs include sediment and temperature modification. The following TMDLs are included in this Water Quality Restoration Plan:
	  o Sediment –St. Regis River, Big Creek, Little Joe Creek, North Fork Little Joe Creek, and Twelvemile Creek
	  o Temperature – Big Creek, Twelvemile Creek, and St. Regis River

Impacted Uses	• Coldwater fishery and aquatic life beneficial uses are negatively impacted from loss of aquatic habitat, temperature conditions and sedimentation
Pollutant Source Descripsions	• Urban Activities: Riparian impacts from low density development on private lands, stream encroachment from structures; historical channelization for land and transportation development; private roads. • Roads and transportation: Forest, federal, and county roads. Sediment production from unpaved roads, stream encroachment from all road types, road sanding on paved road system. Abandoned railroad and state highway. • Agriculture: Historic and current tree harvest on private and State land. Historic tree harvest on federal public land. Very limited areas of grazing, cultivation, and irrigation. • Mining: Recreational Suction Dredge Permits. Historic placer mining.

TMDL Target Development Focus	• Sediment
	  o Fine sediment in riffles and spawning substrate compared to reference condition
	  o Pool quality measures compared to reference conditions
	  o Channel conditions that affect sediment transport compared to reference condition
	  o Biological indicators compared to reference condition
	  o Streambank vegetation comparable to reference condition
	  o Presence of significant human caused sources
	• Temperature
	  o Montana's temperature standard
	  o Temperature conditions compared to naturally occurring conditions or;
	  o Canopy density, instream flow, channel width/depth ratio conditions compared to natural conditions that will cause standards to be exceeded

Other Use Support Objectives (non-pollutant & non-TMDL)	• Improve native riparian vegetation cover. • Improve instream fishery habitat. • Eliminate unnatural fish passage barriers based on fishery goals.
Sediment TMDL and Allocation Summary	• Load allocations provided for: Forest Roads, natural background, bank erosion sources (lumped category), cut slopes along freeway, freeway sanding, culvert failure, and mass wasting events. • An overall percent sediment load reduction is provided for the TMDL and is based on individual percent reduction allocations and also natural background estimates. Estimated annual sediment load allocations to all significant source categories are also provided. Reductions are based on estimates of BMP performance. The annual TMDL is the sum of the allocations. Numeric sediment load based daily TMDLs and daily allocations are also estimated and provided in an appendix.
Temperature TMDLs and Load Allocations	• The temperature TMDLs are provided in surrogate measures because they relate directly to the standard and are most relevant for restoration of the resource. The surrogate allocations are the percent change in source categories (ie shade, width to depth ratios) needed to meet conditions that will meet the State's temperature standards. The TMDL is the combination of the allocations. Numeric heat load

Table E-1. Water Quality Plan and TMDL Summary Information.

	based Daily temperature TMDLs and daily allocations are also estimated and provided in an appendix.
Sediment and Temperature Restoration Strategy	• The restoration strategy identifies general restoration approaches for assessed sources. Addressing the sources in the restoration strategy will likely achieve TMDLs. An adaptive management component is also provided for determining if future restoration will meet targets provided in the document.

ACRONYMS AND ABBREVIATIONS

ARM .... Administrative Rules of Montana
BMP .... Best Management Practice
BLM .... Bureau of Land Management, United States
C .... Celsius
CFR .... Clark Fork River
cfs .... Cubic Feet Per Second
CWA .... Clean Water Act
DNRC .... Department of Natural Resources and Conservation, Montana
EMAP .... Environmental Monitoring and Assessment Program
EPA .... Environmental Protection Agency, United States
EQIP .... Environmental Quality Initiatives Program
F .... Fahrenheit
GIS .... Geographic Information System
GPS .... Global Positioning System
HUC .... Hydrologic Unit (Code) from USGS
IWM .... Irrigation Water Management
Lat. .... Latitude
lbs/yr .... pounds per year
Long. .... Longitude
MDEQ .... Montana Department of Environmental Quality
MDOT .... Montana Department of Transportation
MCA .... Montana Code Annotated
MFWP .... Montana Fish, Wildlife and Parks
mg/l .... Milligrams per liter
MPDES .... Montana Pollutant Discharge Elimination System
n .... number of samples
NPDES .... National Pollutant Discharge Elimination System
NPS .... Nonpoint source pollution
NRCS .... Natural Resource Conservation Service
PFC .... Proper Functioning Condition (Riparian)
QA/QC .... Quality Assurance and Quality Control
SAR .... Sodium Adsorption Ratio
SRF .... State Revolving Fund
SSC .... Suspended Sediment Concentration
TPA .... TMDL Planning Area
TMDL .... Total Maximum Daily Load
USFWS .... United States Fish and Wildlife Service
USFS .... United States Forest Service
USGS .... United States Geological Survey
W/D Ratio .... Width to Depth Ratio
WMA .... Wildlife Management Area
WQB-7 .... Circular WQB-7, Montana Water Quality Standards
WQRP .... Water Quality Restoration Plan

SECTION 1.0 INTRODUCTION

1.1 Background and Purpose

Section 303(d) of the federal Clean Water Act and Section 75-5 of the Montana Water Quality Act provide authority and procedures for monitoring and assessing water quality in Montana's streams and lakes and for developing restoration plans for those waters not meeting state standards. This document presents a water quality restoration plan for the St. Regis River watershed, including the mainstem St. Regis River and several of its tributaries. This plan also defines all necessary Total Maximum Daily Loads (TMDLs) for pollutants of concern in the St. Regis watershed, as specified in the *Montana 303(d) List of Impaired and Threatened Water bodies in Need of Water Quality Restoration*. A TMDL is the total amount of pollutant that a stream may receive from all sources without exceeding water quality standards. A TMDL may also be defined as a reduction in pollutant loading that results in meeting water quality standards.

Water quality impairments affecting the St. Regis River and the above tributaries include sediment, aquatic habitat alterations, and elevated water temperatures that negatively impact trout and other forms of aquatic life. The restoration plan outlined in this document establishes quantitative restoration goals for each impaired stream segment and for each category of offending pollutant. The plan provides recommendations for reducing pollutant loads and improving overall stream health and establishes a monitoring plan and adaptive management strategy for fine-tuning the restoration plan, thus ensuring its ultimate success in restoring water quality in the St. Regis watershed.

1.2 Project Organization

Mineral County Conservation District, the Mineral County Watershed Council, the Montana Department of Environmental Quality, Lolo National Forest, and other agencies and stakeholders contributed to the development of this plan through their participation in the St. Regis watershed TMDL technical work group. The St. Regis TMDL planning area is located entirely in Mineral County, Montana, and encompasses 233,433 acres of largely federally owned lands. Early in this project, the Mineral County Conservation District and the Mineral County Watershed Council assumed a leadership role in water quality restoration planning in the St. Regis watershed. Both groups include a broad mix of local interests including landowners, businesses, and agency representatives. They have designated the St. Regis watershed as one of their highest planning priorities.

In 2002, the Mineral County Conservation District applied for Section 319 funding to begin development of a St. Regis watershed water quality restoration plan. The grant was approved later that year. At the same time, the U.S. Environmental Protection Agency provided grant funding to the Lolo National Forest to assist in the project. The Lolo National Forest is a primary landowner in the St. Regis watershed managing roughly 212,000 acres, or about 91% of the total land area. Additional project funding and in-kind assistance were provided by the Montana Department of Environmental Quality; the Montana Department of Fish, Wildlife, and Parks; the Montana Department of Transportation; and Land & Water Consulting, Inc., which has since merged with PBS&J.

In the summer of 2002, the St. Regis watershed TMDL technical work group was established to oversee the various assessment activities and planning needed to complete this project. The group also coordinated public involvement aspects of the project, distributed informational newsletters, and hosted a number of public meetings and hearings on the project. The work group served as the primary clearinghouse for all aspects of plan development, and will have a significant continuing role in its implementation.

1.3 Water Quality Restoration Planning Process

Development of a TMDL water quality restoration plan follows a series of successive steps, which are described below to provide the reader with a general understanding of the process that was used in developing the St. Regis plan.

The first step in developing a water quality restoration plan is to thoroughly evaluate and describe the water quality problems of concern. This includes understanding the characteristics and function of the watershed, documenting the location and extent of the water quality impairments, and identifying each of the contributing causes and sources of impairment. Pollution source assessments are performed at a watershed scale because all potential sources of the water quality problems must be considered when developing the restoration plan.

The next step in the process is to develop water quality targets, or restoration goals, for each impaired stream segment and for each pollutant of concern. These targets will be used as restoration benchmarks and will help to identify what improvements or restoration measures are needed throughout the watershed. The required pollutant reductions and corresponding restoration measures are then allocated across the watershed planning area. This allocation process may be applied on the basis of land use (e.g. forestry, urban, mining, transportation, etc.), land ownership (federal, state, private), sub-watersheds or tributaries, or any combination of these. Specific allocations are also established for future growth and development in the watershed and for any natural sources of impairment that may be present.

The pollutant allocations and restoration measures become the basis for a water quality restoration strategy, which may include a combination of non-point and point source pollution control measures. Montana has adopted a policy of voluntary compliance for addressing non-point sources of pollution emanating from private lands. As a result, non-point source control measures rely heavily on public education and other programs that encourage private landowners to apply appropriate land, soil, and water conservation practices. Point source pollution is regulated through a state-administered discharge permit program, and any point source allocations that are included in the restoration plan will become a mandatory component of the discharge permits.

Lastly, the water quality restoration plan must include a monitoring component designed to evaluate progress in meeting the water quality targets established by the plan and to ensure that the restoration measures are, in fact, implemented. The monitoring strategy also provides useful information to help fine-tune the restoration plan over the long-term. This process is called adaptive management, and it is a frequent component of watershed-scale restoration plans because of the complexity of the water quality problems and the inherent uncertainties involved with establishing cause-and-effect relationships between pollution sources and their effects over such large geographic areas.

Taken together, the steps in the water quality restoration planning process described above constitute a water quality-based approach to water pollution control, which is also known as the Total Maximum Daily Load process.

SECTION 2.0 WATERSHED CHARACTERIZATION

This section of the St. Regis watershed water quality restoration plan provides general background information about the watershed and sets the stage for a later discussion of water quality problems and the underlying historic, current, and projected future causes of impairment.

2.1 Location and Description of the Watershed

The St. Regis watershed is located entirely in Mineral County, Montana, and encompasses 365 square miles (233,443 acres) of largely federally owned lands (**Figure 2-1**). Tributaries of the St. Regis River include Twelvemile, Silver, Big, Ward, Deer, Little Joe, North Fork Little Joe, and Savenac Creeks, along with several smaller tributaries. The St. Regis River has its headwaters at St. Regis Lakes approximately 3 miles southwest of Lookout Pass on Interstate 90 (I-90) near the Montana-Idaho border. The river flows in a generally southeasterly direction for nearly 39 miles before entering the Clark Fork River at St. Regis, Montana. The elevation at St. Regis Lakes is 5,590 feet, and the river joins the Clark Fork at an elevation of 2,640 feet. The highest point in the watershed is 7,297 feet along the basin's western boundary in the Bitterroot Mountains.

The U.S. Forest Service, Lolo National Forest, has management responsibilities for approximately 91% of the watershed area, or 212,363 acres. Remaining land ownership is divided between private interests (17,230 acres, or 7.4%) and state-owned lands (3,850 acres, or 1.6%). Interstate 90 follows the river most of the way from its headwaters to its confluence with the Clark Fork River at St. Regis.

2.2 Physical and Biological Characteristics

2.2.1 Geological Setting

The St. Regis watershed lies within the northern Rocky Mountains physiographic province and includes parts of the Coeur d'Alene Mountains and Bitterroot and Squaw Peak Ranges of western Montana. The terrain is characterized by steep heavily forested mountains separating the linear intermontane valley occupied by the Clark Fork and St. Regis rivers.

Precambrian Belt clastic and carbonate-bearing rocks, which in descending order include the Prichard Formation (Pre-Ravalli Group); Burke, Revett, and St. Regis Formations (Ravalli Group); Wallace Formation (Piegan Group); and the Spruce, Lupine, Sloway, and Bouchard Formations (Missoula Group), make up most of the watershed's geology. In several localities, lower Paleozoic quartzite, shale, and limestone of probable Middle Cambrian age crop out. Tertiary gravel, sand, and silt deposits and Quaternary lacustrine silt, fluvial gravel, and alluvium are also present within the valley. Igneous rocks ranging in composition from diorite to diabase occur as dikes and sills.

The major geologic structural element is the Osburn fault zone, extending southeastward from Coeur d'Alene, Idaho, district to Superior, Montana, and beyond, possibly as far southeast as Missoula. It is one of the structures in the Lewis and Clark line, described as a northwest tear fault zone of continental scale.

Lead, zinc, copper, and silver ore deposits occur as fissure filling or replacement deposits, of which most are related to the Lewis and Clark line, particularly the Osburn fault. Some ore deposits are associated with diorite dikes and sills.

Total ore production for the St. Regis-Superior area prior to about 1950 amounted to 248,345 tons, from which 7,932,958 pounds of lead, 8,086,827 pounds of zinc, and 2,046,963 pounds of copper were recovered. Placer gold recovered from Mineral County from the period 1904-1945 totaled $614,000 (Montana Water Resource Board 1969).

2.2.2 Climate

Two National Oceanic and Atmospheric Administration (NOAA) stations were selected to represent climatic conditions in the St. Regis watershed (St. Regis Ranger Station #247318 and Haugan 3E #243984). Unfortunately, the elevation range covered by the NOAA stations extends only from 2,680 feet at St. Regis to 3,100 feet at Haugan. It should be noted that elevations in the St. Regis watershed extend to nearly 7,300 feet, and the selected stations do not fully represent meteorological conditions in higher elevation portions of the mountainous region. However, precipitation shows strong orographic effects even across this relatively small elevation change. Annual precipitation at St. Regis averages 20.31 inches/year with 55.8 inches of annual snowfall. Average annual precipitation at the slightly higher elevation station at Haugan averages 29.5 inches/year with 113.2 inches of annual snowfall (**Figure 2-2**). While elevation differences undoubtedly account for some of the variability in precipitation between these sites, weather patterns are also strongly influenced by the surrounding mountains. NOAA climate data were obtained from the Western Regional Climate Center at http://www.wrcc.dri.edu/summary/climsmmt.html.

Average annual precipitation and temperature patterns for the two stations are presented in **Figures 2-3 through 2-8**. Temperature patterns are similar for both stations, with July and August being the warmest months and December and January the coldest months. Summertime highs are typically in the mid-eighties Fahrenheit, and winter lows typically fall into the mid- to low-teens (**Table 2-1**). Precipitation records show that most precipitation at Haugan and St. Regis occurs in the form of snowfall during the months of November through March, followed by rain in May and June. Average annual precipitation at these two sites ranges from about 20 inches at St. Regis to nearly 30 inches at Haugan.

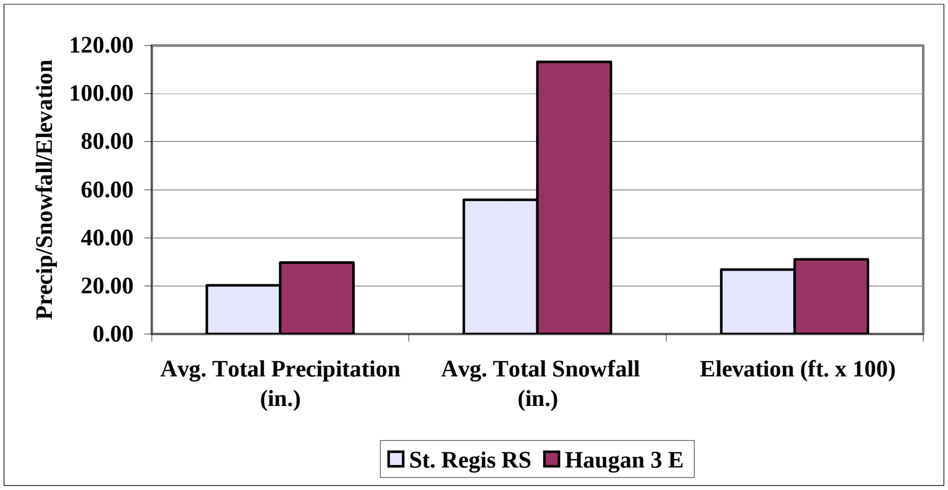

Figure 2-1. Average annual snowfall and precipitation at the St. Regis Ranger Station and Haugan 3 E NOAA climate stations

Table 2-1. Average minimum and maximum temperatures at the Haugan and St. Regis NOAA climate stations (degrees F), 1912-2003

Station	Average January Min/Max Temperatures	Average July Min/Max Temperatures	Average Annual Min/Max Temperatures
Haugan 3 E	12.6/31.7	41.3/84.3	28.0/57.4
St. Regis R.S.	18.1/33.5	45.3/85.8	31.2/59.1

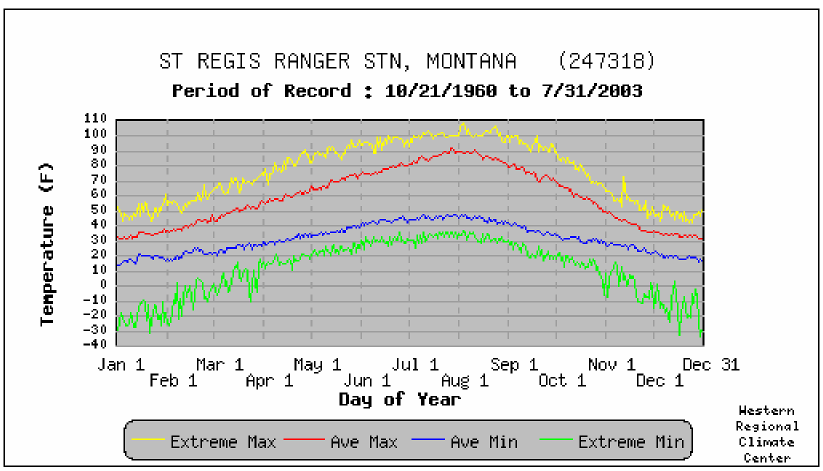

Figure 2-2. Daily temperature averages and extremes (degrees F) at the St. Regis RS NOAA climate station, 1960-2003

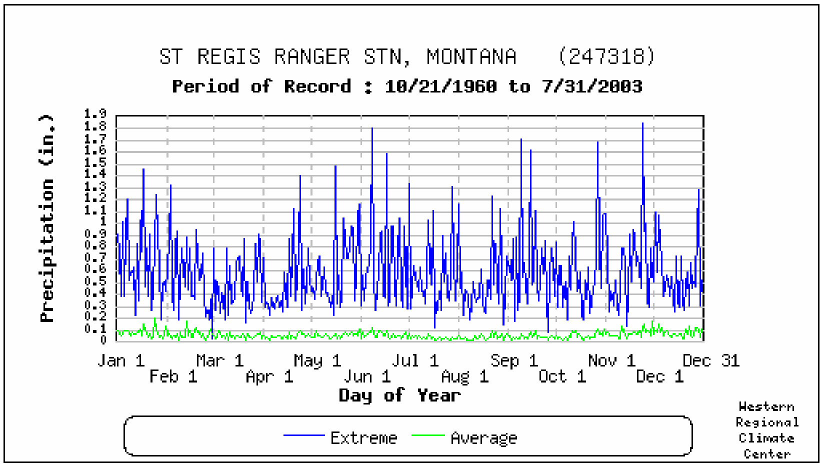

Figure 2-3. Daily precipitation averages and extremes (inches) at the St. Regis RS NOAA climate station, 1960-2003

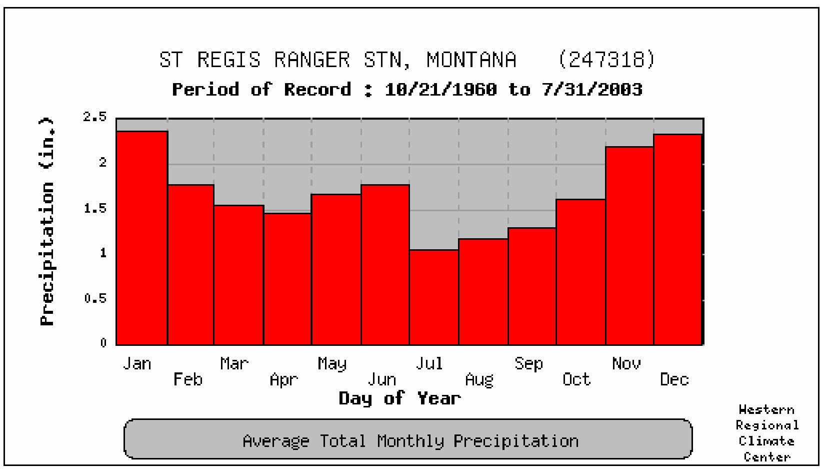

Figure 2-4. Monthly average total precipitation (inches) at the St. Regis RS NOAA climate station, 1960-2003

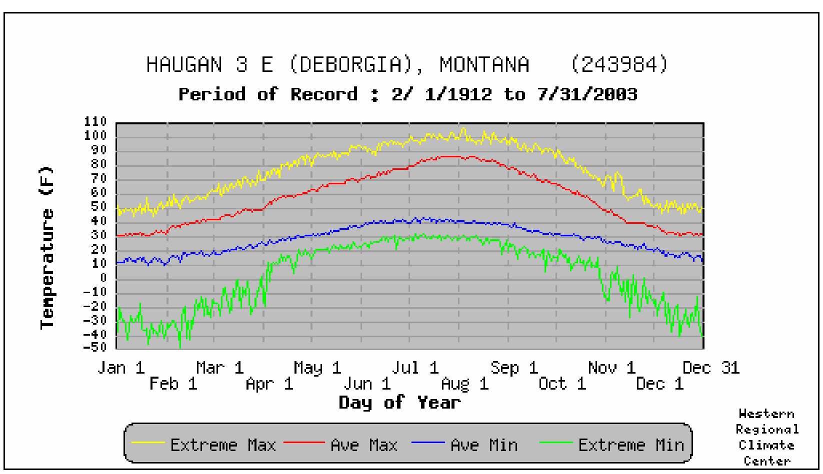

Figure 2-5. Daily temperature averages and extremes (inches) at the Haugan 3 E NOAA climate station, 1912-2003

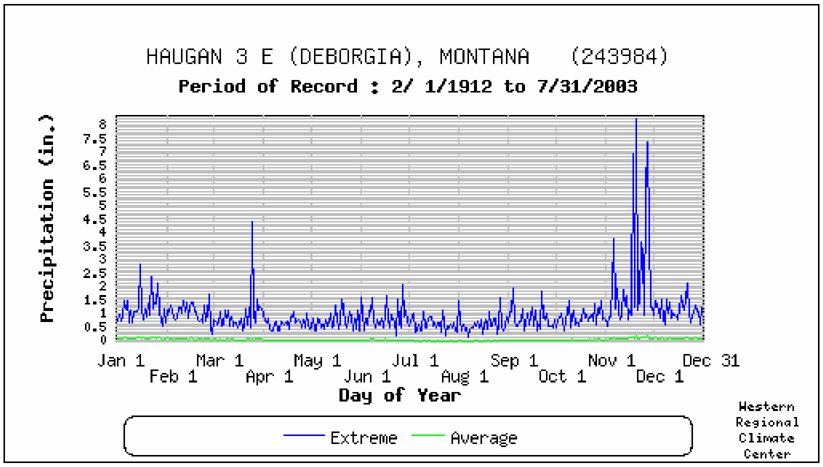

Figure 2-6. Daily precipitation averages and extremes (inches) at the Haugan 3 E NOAA climate station, 1912-2003

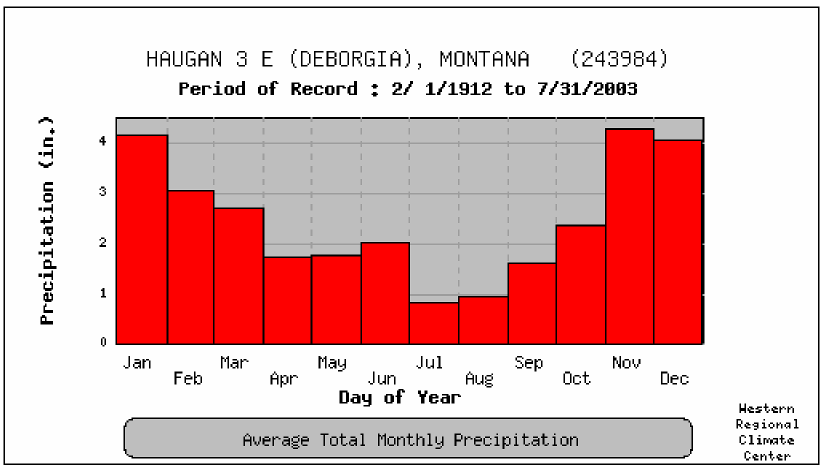

Figure 2-7. Monthly average total precipitation (inches) at the Haugan 3 E NOAA climate station, 1912-2003

2.2.3 Hydrology

The U.S. Geological Survey (USGS) water resources information database lists three streamflow gaging stations with current or historical flow data within the St. Regis watershed (**Table 2-2**) (http://waterdata.usgs.gov/nwis/). Continuous long-term flow data were only available for one station, the St. Regis River near St. Regis, while periodic peak flow measurements were available at the remaining two stations, East Fork Timber Creek and North Fork Little Joe Creek. Monthly average streamflows for the St. Regis River, and peak flow measurement data for all three stations are presented in **Figures 2-9 and 2-10** to provide a general picture of seasonal streamflow characteristics in the St. Regis watershed.

Table 2-2. Historical USGS streamflow gaging stations in the St. Regis watershed

USGS #	Station ID	Period of Record	Drainage Area (mi^2)
12353850	East Fork Timber Creek near Haugan, MT	1961-1979	2.7
12354000	St. Regis River near St. Regis, MT	1910-1917, 1958-1975, 2002-present	303
12354100	North Fork Little Joe Creek near St. Regis, MT	1960-1974	14.7

Average discharge patterns for the St. Regis River near St. Regis gaging station are presented in **Figure 2-9**. Except for during the spring runoff period, streamflows in the St. Regis River do not vary by a large margin and generally range from the about 130 to 300 cfs. Spring high flows begin in April, the hydrograph peaks in May or early June, and the recessional limb begins in June. Peak flows are typically about ten-fold higher than base flow levels, although considerable year-to-year variation can be expected. Peak streamflows in the St. Regis River (**Figure 2-10**) reach 5,000 cfs with some frequency, and flows as high as 29,000 cfs have been recorded. The highest flows were recorded in December 1934 (34,000 cfs), May 1954 (11,000 cfs), and January 1974 (9,640 cfs). The winter floods in 1934 and 1974 were associated with rain on snow events. Peak flow events in the North Fork Little Joe Creek ranged from less than 100 cfs to almost 300 cfs.

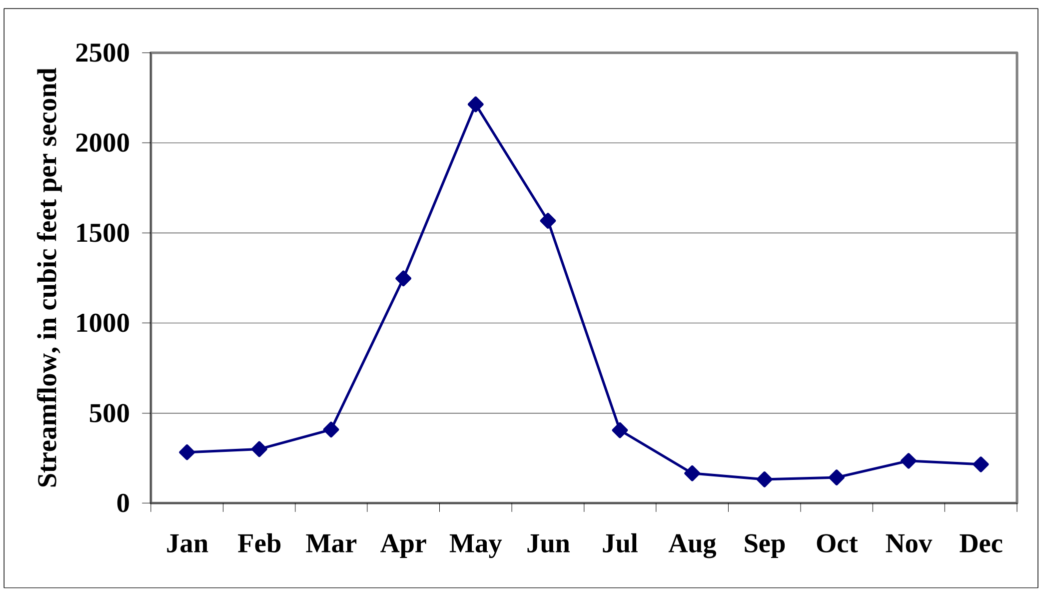

Figure 2-8 Average monthly streamflow for the St. Regis River near St. Regis, MT, 1910-2002 (USGS gaging station 12354000).

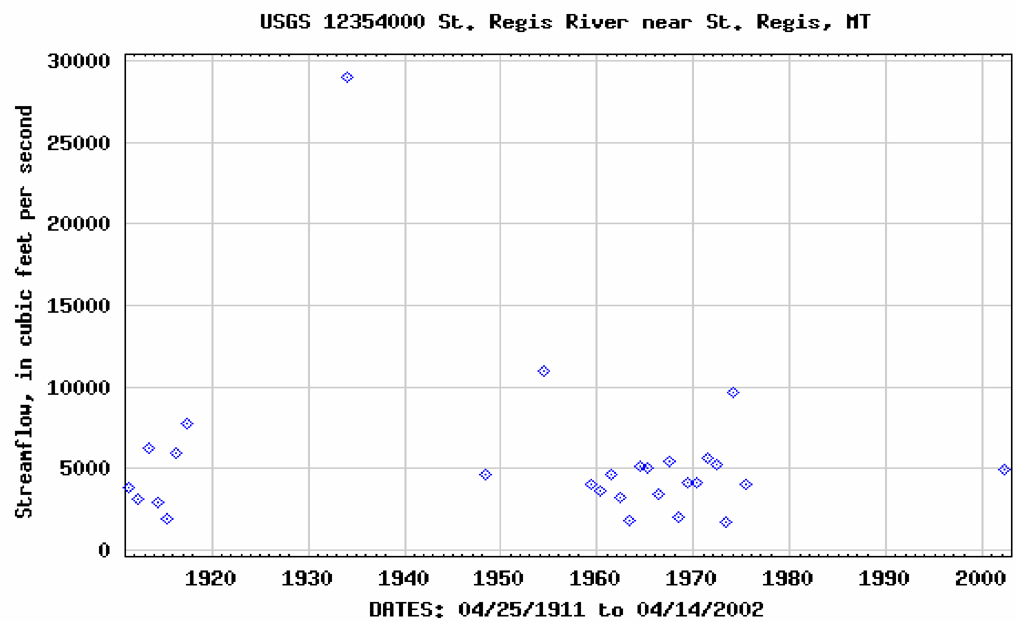

Figure 2-9 Peak streamflows measured in the St. Regis River near St. Regis, MT, 1910-2002 (USGS gaging station 12354000).

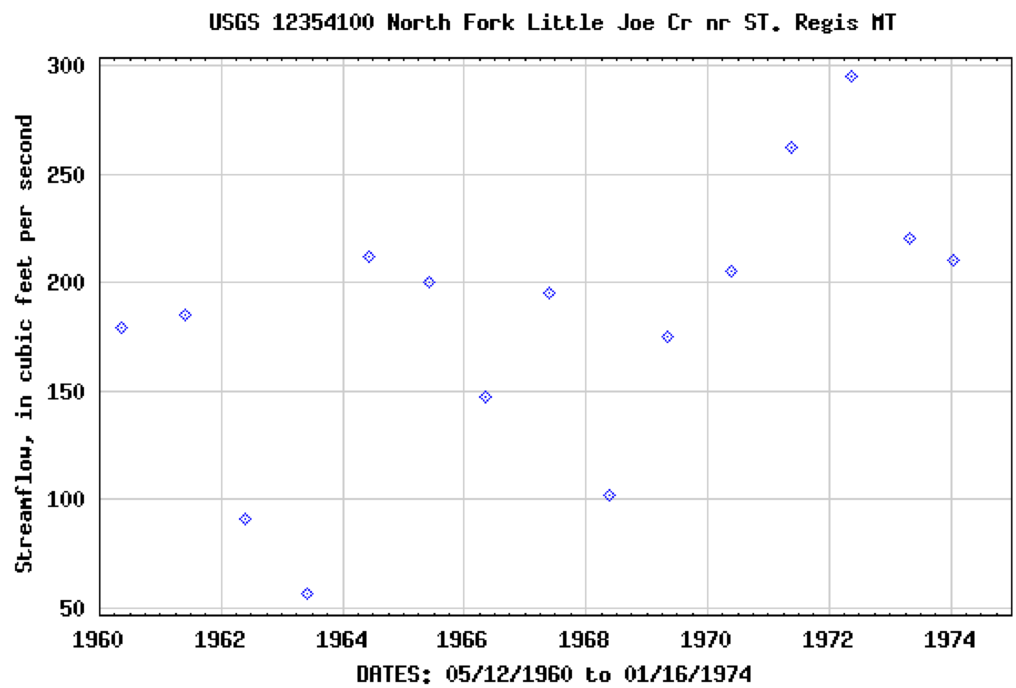

Figure 2-10 Peak streamflows measured in the North Fork Little Joe Creek near St. Regis, MT, 1960-1974 (USGS gaging station 12354100).

2.2.4 Topography

Topographic maps displaying the distribution of elevation, slope, and shaded relief were created for the St. Regis watershed planning area. These data were obtained from the United States

Geological Survey's National Elevation Dataset for Montana, available at: http://nris.state.mt.us/nsdi/nris/ned.html.

Relief in the St. Regis watershed varies from approximately 2,500 feet at the St. Regis River's confluence with the Clark Fork River at St. Regis to 7,500 feet in the Bitterroot Mountains (**Table 2-3**). Roughly half of the topography in the watershed occurs above 4,500 feet. Approximately 99% of lands in the St. Regis watershed occur below 7,500 feet.

All slope categories, from flat (<1%) to extremely steep (≥100%), are present within the St. Regis watershed (**Table 2-4**). In general, the topography of the watershed is steep with approximately 80% of the watershed area comprised of slopes greater that 25% in pitch. About one-third of the watershed area is comprised of lands with 25-45% slopes, and almost one-half of the watershed is comprised of lands with greater than 45% slopes.

Table 2-3 Elevation in the St. Regis watershed.

Elevation (ft)	Acres	Percent of Area	Cumulative Percentage
2,500 to 3,499	25,812	11.06	11.06
3,500 to 4,499	84,411	36.17	47.23
4,500 to 5,499	90,837	38.93	86.16
5,500 to 6,499	30,906	13.24	99.40
6,500 to 7,500	1,398	0.60	100.00
Totals	233,364	100%	

Table 2-4 Slope in the St. Regis watershed.

Slope (%)	Acres	Percent of Area	Cumulative Percentage
< 1%	917	0.39	0.39
1 to <5%	4388	1.88	2.27
5 to <10%	6600	2.83	5.10
10 to <25%	32112	13.76	18.86
25 to <45%	86807	37.20	56.06
45 to <100%	102382	43.88	99.94
≥ 100%	140	0.06	100.00
Totals	233,346	100%	

2.2.5 Stream Morphology

The St. Regis River has its headwaters at St. Regis Lakes approximately 3 miles southwest of Lookout Pass on Interstate 90. After flowing northeast for approximately 2.5 miles, the river intercepts the old Northern-Pacific Railroad grade and shortly thereafter the old Lookout Pass highway and I-90 road grades. The river then flows through the narrow St. Regis Canyon to its confluence with the Clark Fork River at the town of St. Regis.

The St. Regis River channel is heavily impacted throughout much of its 39-mile length. The river valley is a major transportation corridor. Over the last 100 years, two railroads, a two-lane highway, and a four-lane interstate highway have been crowded within the valley. The river has been relocated, straightened, and confined. Its natural meandering length has been reduced by approximately 20%.

The existing river with structurally armored banks and a shorter, steeper, straighter, bed has higher "stream power" or available energy. Because the banks are protected, this increased energy attacks the streambed and anything else mobile in the channel. Gravel-sized and smaller particles have been carried downstream for years and redeposited where the river gradient decreases and the valley becomes wider a couple of miles west of the town St. Regis. These gravel deposits are clearly visible from Interstate 90 between St. Regis and the Little Joe Road overpass.

Large woody debris material critical for fish habitat and channel structure is virtually absent from the river. Riparian trees were cleared for transportation corridors, used as fuel wood or in construction, or flushed downstream. The majority of the riparian area was either filled or otherwise altered for roads, railroads, or structures preventing regrowth of riparian trees.

Analysis of changes in the river's natural channel morphology and consequences to sediment transport dynamics, fish habitat components, and water temperature patterns are major components of the St. Regis watershed pollution source assessment discussed in **Section 5.0** of this report.

2.2.6 Vegetation Cover

Information on vegetation cover within the St. Regis watershed were obtained from Gap Analysis Program (GAP) data contained within the Montana 90-meter land cover database available from the Montana State Library Natural Resource Information System (http://nris.state.mt.us/nsdi/nris/gap90/gap90.html). The GAP vegetation classifications were developed by the U.S. Geological Survey from satellite imagery collected in the 1990s (**Table 2-5**). The vegetation classifications are highly detailed and attempt to differentiate individual species within general community types (i.e. ponderosa pine vs. coniferous forests). Subsequent ground-truthing has shown that GAP data have limitations, and the classification of individual species polygons are of variable quality. Nevertheless, GAP data represent the best vegetation classification information available at a landscape scale.

Approximately 90% of the St. Regis watershed area is comprised of coniferous forest, with some higher elevation meadows and parklands. The GAP data recognize eight distinct vegetation classifications within the overall forested area. These are mixed mesic, Douglas-fir, mixed subalpine, lodgepole pine, mixed mesic shrubs/forest, Douglas-fir/lodgepole pine, western larch, and montaine parklands/subalpine meadows (**Table 2-5**). The remaining 10% of the watershed area is composed of six other coniferous vegetation types and 19 other vegetation types. Within the entire St. Regis watershed, riparian vegetation comprises less than 2% of the land area, and grasslands and urban, developed, and mined lands make up less than 1%.

Historical wildfires, most notably the great burn of 1910, have had a major influence on vegetation characteristics present today on the St. Regis watershed. Most of the 1910 fires were stand replacing, and in the St. Regis drainage it appears that most of the burns occurred in the upper half of the watershed. Estimates provided by the Lolo National Forest suggest that about 42% (98,753 acres) of all lands within the St. Regis drainage burned during the 1910 fires. The initial fires, and subsequent salvage logging and reforestation efforts, have been a factor in determining species distribution and age structures present today (Lolo National Forest, 2001).

Table 2-5. Vegetation classification (GAP) within the St. Regis watershed

Gap Vegetation Type	Acres	Percent of Area	Cumulative Percentage
Mixed Mesic Forest	98,156	42.06	42.06
Douglas-fir	29,237	12.53	54.58
Mixed Subalpine Forest	27,730	11.88	66.47
Lodgepole Pine	26,427	11.32	77.79
Mixed Mesic Shrubs	11,104	4.76	82.55
Douglas-fir / Lodgepole Pine	7,725	3.31	85.86
Western Larch	5,725	2.45	88.31
Montane Parklands/ Subalpine Meadows	4,020	1.72	90.03
Mixed Xeric Forest	3,905	1.67	91.71
Rock	3,340	1.43	93.14
Western Hemlock	2,874	1.23	94.37
Grand Fir	2,137	0.92	95.28
Ponderosa Pine	1,907	0.82	96.10
Conifer Riparian	1,641	0.70	96.80
Mixed Riparian	1,143	0.49	97.29
Mixed Barren Sites	1,135	0.49	97.78
Grassland (low-moderate cover)	952	0.41	98.19
Western Red Cedar	944	0.40	98.59
Shrub Riparian	758	0.32	98.92
Mixed Broadleaf and Conifer Forest	748	0.32	99.24
Mixed Broadleaf Forest	575	0.25	99.48
Grassland (very low cover)	183	0.08	99.56
Broadleaf Riparian	181	0.08	99.64
Grassland (moderate-high cover)	175	0.08	99.71
Altered Herbaceous	166	0.07	99.79
Standing Burnt Forest	131	0.06	99.84
Graminoid and Forb Riparian	111	0.05	99.89
Water	100	0.04	99.93
Mixed Conifer and Broadleaf Riparian	71	0.03	99.96
Urban or Developed Lands	37	0.02	99.98
Mixed Whitebark Pine Forest	26	0.01	99.99
Mixed Xeric Shrubs	16	0.01	100.00
Mines, Quarries, Gravel Pits	8	0.00	100.00
Totals	233,390	100%	

2.2.7 Fisheries

This section provides a summary of fish species distribution in the St. Regis watershed, as well as the status of species of special concern known to occur in the area.

The St. Regis watershed provides habitat for bull, rainbow, brook, brown, and westslope cutthroat trout; mountain whitefish; and several species of suckers and sculpins (**Table 2-6**). Bull trout (*Salvelinus confluentus*) are native to the St. Regis River and its tributaries and, as part of the Columbia River Basin population, were listed as threatened under the Endangered Species Act in July 1998. The bull trout also appears on the State of Montana's Animal Species of

Special Concern list with a state rank of S2. An S2 rank is described as “imperiled because of rarity or because of other factors demonstrably making it very vulnerable to extinction throughout its range” (Carlson 2001). It is also listed as a “sensitive species” by the U.S. Forest Service, which is defined as “those plant and animal species identified by a Regional Forester for which population viability is a concern as evidenced by (a) significant current or predicted downward trends in population numbers or density or (b) significant current or predicted downward trends in habitat capability that would reduce a species’ existing distribution (USDA 1995).

Table 2-6. Native and introduced fish species in the St. Regis watershed

Native Fish Species
Bull trout (*Salvelinus confluentus*)
Westslope cutthroat trout (*Oncorhynchus clarki lewisi*)
Mountain whitefish (*Prosopium williamsoni*)
Longnose dace (*Rhinichthys cataractae*)
Mottled sculpin (*Cottus bairdi*)
Large-scaled sucker (*Catostomus macrocheilus*)
Longnose sucker (*Catostomus catostomus*)
Introduced Fish Species
Rainbow trout (*Oncorhynchus mykiss*)
Brown trout (*Salmo trutta*)
Brook trout (*Salvelinus fontinalis*)

Seven of the eight stream segments that appeared on the 1996 303(d) List have existing populations of bull trout (**Figure 2-1**). The entire St. Regis watershed is identified as a core habitat area. Core habitat areas historically have and currently contain the strongest bull trout populations, and these habitats are essential to the continued existence of the species (MBTRT 1996). Additionally, all streams that are on either the 1996 or 2004 303(d) Lists have temperature and/or sediment listed as probable causes of impairment. Appropriate temperature and sediment regimes are both critical habitat requirements for bull trout (MBTRT 1996, Weaver and Fraley 1991).

Westslope cutthroat trout (*Oncorhynchus clarki lewisi*) are present in the entire St. Regis watershed. Westslope cutthroat trout is included on the State of Montana's list of Animal Species of Special Concern (Carlson 2001) with a state rank of S2. Westslope cutthroat trout are also listed as “sensitive” by the USFS and are given “special status” by the BLM, the latter defined as a “federally-listed Endangered, Threatened, or Candidate species or other rare or endemic species that occur on BLM lands.”

Because of the above-described special designations, bull trout and westslope cutthroat trout will require special consideration during the development and implementation of the St. Regis water quality restoration plan as it pertains to existing or potential habitat areas and environmental requirements.

2.3 Cultural Characteristics

2.3.1 History of Settlement

The following discussion has been excerpted from the Mineral County Water Resources Survey and provides a summary of the history of human settlement in the St. Regis watershed and adjacent areas of Mineral County (Montana Water Resources Board 1969).

The area known as Mineral County was probably visited by the fur trappers and traders of the early 1800s, but the first recorded visitors were the Jesuit Missionaries during the 1840s. These included Fathers DeSmet, Cataldo, Grossi, and Ravalli. The country they saw was the heavily timbered slope and valleys of the Clark Fork of the Columbia and the St. Regis Rivers.

In 1850, Major John Owen, a trader, inaugurated an annual trip to the Dalles traveling the route down the Clark Fork River, up the St. Regis River, and over Lookout Pass. In 1858 the possibilities of further settlement were enhanced when U.S. Army captain John Mullan arrived in the area to construct the military road that now bears his name. He spent the winter of 1859 in a camp near the present town of DeBorgia. The Mullan Road, as it was known, was completed to Walla Walla in 1861. In 1880 the area around the St. Regis House, in the present town of Saltese, started to develop with the opening of mines to the north along Packer Creek. The community of Silver City grew up around the old St. Regis House when the railroad came though in 1891. At this time the name of Silver City was changed to Saltese in honor of a Nez Perce chieftain.

With the completion of the Northern Pacific Railroad over the mountains to Wallace, Idaho, in 1891, the lumber and sawmill industry boosted the sagging economy of the area and a number of mill towns grew up around the sawmills. The most notable of these sawmill towns were Lothrop, Superior, DeBorgia, and St. Regis. The town of Lothrop has since disappeared from the scene.

In 1908 the Northern Pacific line finished the cut-off route between St. Regis and Paradise. At the same time the Milwaukee Railroad was building its line through the country. The activity of these two railroads gave St. Regis the impetus needed to establish a permanent community.

In the summer of 1910 a series of forest fires started in Idaho across the mountain from Saltese. By August of that year these fires had all coalesced creating a solid front. The wind carried the fire into western Montana, and sparks and coals were pushed far in advance, starting numerous fires ahead of the main body of the conflagration. Before the fire it was estimated that 28 years of potential logging was available in the burned out area, and afterwards the accessible timber remaining was limited to four years of logging. Subsequently, logging declined until access roads could be built to the larger stands of virgin timber. In the year or two following the big fire, a nursery was established at Haugen to raise seedlings for replanting the burned over area. This nursery was rated as the largest of its kind in the world. The major species of trees raised were White pine, Ponderosa Pine, Western larch, Douglas fir, and Engelmann spruce.

Agriculture has played only a minor role in the settlement and economy of Mineral County. The heavily timbered valleys and hillsides precluded any extensive development of farming and stock raising. Most of the valley bottoms are not extensive enough for any large scale ranching and farming operations.

2.3.2 Present Land and Water Uses

According to a 2001 estimate, Mineral County has a population of 3,843 people. Within the St. Regis watershed, there is an estimated population of 500 in St. Regis, 100 in both Saltese and DeBorgia, and an estimated population of 50 in Haugen.

Current and historic land uses within the St. Regis watershed include timber harvest, mining, and recreation. Approximately 91% of the watershed is federally-owned, less than 2% is state-owned and slightly more than 7% is privately owned lands. The majority of the watershed is mountainous with heavy coniferous timberlands. There is very little open grassland to support livestock grazing, and most historic land uses have centered around timber harvest for the lumber industry. The St. Regis drainage historically has been used as a transportation corridor, beginning with the Mullan Road, and continuing on to the Northern Pacific and Chicago, Milwaukee, St. Paul, and Pacific Railroads; state highway 10; and Interstate 90.

Water uses in the St. Regis watershed include fisheries and recreation, limited irrigation, municipal water supply, and hydropower production. Avista Corporation maintains a large senior water right for hydroelectric power production at Noxon Rapids and Cabinet Gorge dams on the Clark Fork River downstream of the confluence with the St. Regis River. While this water right is not within the St. Regis watershed, it presents a limiting factor to junior water uses throughout much of the Clark Fork drainage, including the St. Regis River.

SECTION 3.0 TMDL REGULATORY FRAMEWORK

This section of the St. Regis watershed water quality restoration plan describes the applicable water quality standards, and reviews the water quality and water use-support status of St. Regis basin streams in relation to those standards. A review of the available water quality data is also provided for each threatened or impaired stream segment.

3.1 TMDL Development Requirements

Waters of the State of Montana must fully support beneficial uses associated with their classification and water quality standards (MCA 75-5-703, ARM 17.30.606-614 and 17.30.620-629). Beneficial water uses that apply to all Montana water bodies include cold or warm water fisheries, aquatic life, drinking water, contact recreation (e.g. swimming), and agricultural and industrial uses. DEQ determines the level of beneficial use-support of surface waters according to the following definitions:

> *A use is fully supported when all water quality standards applicable to that use are met. When one or more standards are not met due to human activities, the water body is either "not supporting" or "partially supporting" the beneficial use tied to that standard. A use that is currently fully supported but for which observed trends or proposed new sources of pollution indicate a high probability of future impairment may be rated as "threatened." Because the standards for determining use support are different for each use, the use-support determinations for the various uses of a waterbody are often not the same. Only those beneficial uses that apply to the particular water-use classification of a waterbody are evaluated for that waterbody* (MDEQ 2004a).

Water bodies that do not support, or are unlikely to support, all of their designated beneficial uses due to other than natural causes are classified as “water quality-limited” and are summarized on the Montana 303(d) List prepared by the DEQ[1]. 303(d) refers to a section of the federal Clean Water Act, which describes surface water quality monitoring and assessment requirements. The Montana 303(d) List provides a report of impaired and threatened water bodies in need of TMDLs for those impairment or threatened conditions that are linked to pollutants. These TMDLs, along with additional planning to address non-pollutant causes of impairment, will ensure the full support of all beneficial uses when implemented. The 303(d) List includes identification of the probable cause(s) of the water quality impairment problems (e.g. pollutants such as sediment, metals, or nutrients), and the suspected source(s) of the pollutants of concern (e.g. various land use activities). The Montana 303(d) List is published biennially.

Prior to 2004, a 305(b) Report documenting waters listed as fully supporting beneficial uses and waters that lacked sufficient credible data was published along with the 303(d) List. In 2006, the 303(d) List was combined with the 305(b) Report into the *2006 Montana Water Quality Integrated Report*. The 2006 Integrated Report reflects water quality assessments conducted by the DEQ as of December 2005. The 2006 Integrated Report incorporates new guidance from the

[1] DEQ refers to the Montana Department of Environmental Quality unless otherwise noted.

United States Environmental Protection Agency (EPA) which requires total maximum daily loads (TMDLs) be developed for waters impaired by "pollutants," such as nutrients, sediment, or metals. TMDLs are not required for waters impaired solely by "pollution," such as flow alterations or habitat degradation (MDEQ 2004a).

Water bodies appearing on the 1996 and 1998 303(d) Lists were subsequently re-evaluated using more rigorous review criteria during the preparation of the 2000 and 2002 303(d) Lists and, most recently, the 2004 Integrated Report. The review criteria were revised as a result of 1997 amendments to the Montana Water Quality Act pertaining to the 303(d) Listing and water quality restoration planning processes. The 1997 changes require the consideration of "all currently available data," and a determination that adequate data of sufficient quality are available for a particular stream, before a 303(d) Listing decision can be made. DEQ has developed specific decision criteria for evaluating "sufficient credible data" and for making "beneficial use determinations" (MDEQ 2002). Sufficient credible data (SCD) is defined under Montana Law as *"chemical, physical, or biological monitoring data, alone or in combination with narrative information, that supports a finding as to whether a water body is achieving compliance with applicable water quality standards"* (75-5-103 MCA).

The 2004 303(d) List is the most recently approved by DEQ, but by federal court order DEQ must also address all pollutant waterbody combinations appearing on the 1996 303(d) List. Total Maximum Daily Loads must be developed for all pollutants appearing on either the 2004 and 1996 303(d) Lists, except where the later listing represents a refinement of the original listing (based on sufficient and credible data), the sufficient credible data indicates that the basis for the original listing was in error, or that water quality standards are presently being attained and a listing is no longer valid.

3.2 Water Bodies and Pollutants of Concern

A St. Regis TMDL planning area has been established by DEQ. A total of eight individual stream segments in the St. Regis watershed appeared on the 1996 303(d) List, while six segments appeared on the 2006 303(d) List (**Table 3-1, Figure 2-1)**. As mentioned earlier in this section, all necessary TMDLs must be completed for all pollutant/water body combinations appearing on the 1996 303(d) List. Following the reassessment efforts in 2001, Deer and Ward Creeks were determined to be in full support of all designated water uses, and they were removed from the 2002 303(d) List. The St. Regis River's status remained unchanged from the 1996 listing, while the status of four streams – Twelvemile, Big, Little Joe, and North Fork Little Joe Creeks – changed from "threatened" for coldwater fisheries uses in 1996 to "partially supporting" coldwater fisheries and aquatic life in 2006. The status of Silver Creek changed from 'threatened" for coldwater fisheries in 1996, to "partially supporting" coldwater fisheries in 2006.

Table 3-1. Stream segments in the St. Regis TMDL Planning Area that appear on Montana's 303(d) List of Impaired Waters, and their associated levels of beneficial use-support

Water body & Stream Description	Water body #	Use Class	Year	Aquatic Life	Coldwater Fishery	Drinking Water	Swimmable (Recreation)	Agriculture	Industry
St. Regis River from headwaters to the mouth (Clark Fork River)	MT76M003-010	B-1	1996	P	P	X	X	X	X
			2006	P	P	F	F	F	F
Twelvemile Creek from headwaters to the mouth (St. Regis River)	MT76M003-020	B-1	1996	X	T	X	X	X	X
			2006	P	P	F	F	F	F
Silver Creek from headwaters to the mouth (St. Regis River)	MT76M003-030	A-1	1996	X	T	X	X	X	X
			2006	F	P	F	F	F	F
Big Creek from the East and Middle Forks to the mouth (St. Regis River)	MT76M003-040	B-1	1996	X	T	X	X	X	X
			2006	P	P	F	F	F	F
Deer Creek from headwaters to the mouth (St. Regis River)	MT76M003-050	B-1	1996	X	T	X	X	X	X
			2006	F	F	F	F	F	F
Ward Creek from headwaters to the mouth (St. Regis River)	MT76M003-060	B-1	1996	X	T	X	X	X	X
			2006	F	F	F	F	F	F
Little Joe Creek from the North Fork to the mouth (St. Regis River)	MT76M003-070	B-1	1996	X	T	X	X	X	X
			2006	P	P	F	F	F	F
North Fork Little Joe Creek from headwaters to the mouth (Little Joe Cr.)	MT76M003-080	B-1	1996	X	T	X	X	X	X
			2006	P	P	F	F	F	F

F= Full Support; **P**= Partial Support; **N**= Not Supported; **T**= Threatened; **X** = Not Assessed.

Water quality impairment causes in the St. Regis watershed reflected on the 2006 303(d) List included sediment (siltation), temperature, habitat related impairments, and flow alterations (**Table 3-2**). Probable sources of impairments identified on the 2006 list include runoff and other impacts from transportation corridors, silviculture, removal of riparian vegetation, bank modification/destabilization, channelization, and other habitat modifications.

Table 3-2. Probable causes and sources of impairment for 303(d)-listed stream segments in the St. Regis TMDL Planning Area

Water body	1996 Causes	1996 Sources	2006 Causes	2006 Sources
St. Regis River	Other habitat alterations	Highway/road/bridge construction	Other flow regime alterations	Channelization
	Siltation	Silviculture	Alteration in stream-side or littoral vegetative covers	Highway/road/bridge runoff
			Sedimentation/Siltation	Highways, Roads, Bridges, Infrastructure
			Water Temperature	Loss of Riparian Habitat
				Streambank Modifications/destabilization
Twelvemile Creek	Other habitat alterations	Highway/road/bridge construction	Sedimentation/Siltation	Silviculture Activities
	Siltation	Silviculture	Water Temperature	Loss of Riparian Habitat
			Physical Habitat Substrate Alterations	Forest Roads
				Channelization
				Highway/road/bridge runoff

Table 3-2. Probable causes and sources of impairment for 303(d)-listed stream segments in the St. Regis TMDL Planning Area

Water body	1996 Causes	1996 Sources	2006 Causes	2006 Sources
				Highways, Roads, Bridges, Infrastructure
Silver Creek	Thermal modifications	Agriculture	Other flow regime alterations	Highways, Roads, Bridges, Infrastructure
		Irrigated crop production		Flow Regulation/modification
				Impacts from Hydrostructure
Big Creek	Thermal modifications	Highway/road/bridge construction	Sedimentation/Siltation	Loss of Riparian Habitat
		Silviculture	Water Temperature	Channelization
				Streambank Modifications/destabilization
Deer Creek	Thermal modifications	Agriculture	(fully supporting uses)	(fully supporting uses)
		Irrigated crop production		
Ward Creek	Other habitat alterations	Agriculture	(fully supporting uses)	(fully supporting uses)
	Thermal modifications	Highway/road/bridge construction		
		Irrigated crop production		
Little Joe Creek	Other habitat alterations	Highway/road/bridge construction	Other habitat alterations	Highways, Roads, Bridges, Infrastructure
				Natural Sources
	Siltation	Silviculture	Sedimentation/Siltation	Streambank Modifications/destabilization
North Fork Little Joe Creek	Other habitat alterations	Highway/road/bridge construction	Sedimentation/Siltation	Construction
	Siltation			Highway/road/bridge construction

3.3 Applicable Water Quality Standards

Water quality standards include the uses designated for a water body, the legally enforceable standards that ensure that the uses are supported, and a non-degradation policy that protects the high quality of a water body. The ultimate goal of this water quality restoration plan, once implemented, is to help ensure that all designated beneficial uses are fully supported and all standards are met for streams in the St. Regis watershed, particularly those identified as impaired on the 303(d) List. Water quality standards form the basis for the targets described in **Section 4**. Pollutants addressed in this Water Quality Restoration Plan include sediment and thermal modifications. This section provides a summary of the applicable water quality standards for each of these pollutants.

3.3.1 Classification and Beneficial Uses

Classification is the assignment (designation) of a single use or group of uses to a water body based on the potential of the water body to support those uses. Designated Uses or Beneficial Uses are simple narrative descriptions of water quality expectations or water quality goals. There are a variety of "uses" of state waters including growth and propagation of fish and associated aquatic life, drinking water, agriculture, industrial supply, and recreation and wildlife. The Montana Water Quality Act (WQA) directs the Board of Environmental Review (BER, i.e., the state) to establish a classification system for all waters of the state that includes their present (when the Act was originally written) and future most beneficial uses (Administrative Rules of Montana (ARM) 17.30.607-616) and to adopt standards to protect those uses (ARM 17.30.620-670).

Montana, unlike many other states, uses a watershed based classification system with some specific exceptions. As a result, *all* waters of the state are classified and have designated uses and supporting standards. All classifications have multiple uses and in only one case (A-Closed) is a specific use (drinking water) given preference over the other designated uses. Some waters may not actually be used for a specific designated use, for example as a public drinking water supply; however, the quality of that water body must be maintained suitable for that designated use. When natural conditions limit or preclude a designated use, permitted point source discharges or non-point source discharges may not make the natural conditions worse.

Modification of classifications or standards that would lower a water's classification or a standard (i.e., B-1 to a B-3), or removal of a designated use because of natural conditions can only occur if the water was originally misclassified. All such modifications must be approved by the BER, and are undertaken via a Use Attainability Analysis (UAA) that must meet EPA requirements (40 CFR 131.10(g), (h), and (j)). The UAA and findings presented to the BER during rulemaking must prove that the modification is correct and all existing uses are supported. An existing use cannot be removed or made less stringent.

Descriptions of Montana's surface water classifications and designated beneficial uses are presented in **Table 3-3.** Within the St. Regis TPA, Silver Creek is classified as A-1, while Big Creek, Little Joe Creek, North Fork Little Joe Creek Twelvemile Creek, and the St. Regis River are classified as B-1.

Table 3-3. Montana surface water classifications and designated beneficial uses

Classification	Designated Uses
A-1 CLASSIFICATION:	Waters classified A-1 are to be maintained suitable for drinking, culinary and food processing purposes after conventional treatment for removal of naturally present impurities.
B-1 CLASSIFICATION:	Waters classified B-1 are to be maintained suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

3.3.2 Standards

In addition to the Use Classifications described above, Montana's water quality standards include numeric and narrative criteria as well as a nondegradation policy that currently applies to the numeric criteria.

Numeric surface water quality standards have been developed for many parameters to protect human health and aquatic life. These standards are in the Department Circular WQB-7 (MDEQ, 2004b). The numeric human health standards have been developed for parameters determined to be toxic, carcinogenic, or harmful and have been established at levels to be protective of long-term (i.e., life long) exposures, as well as through direct contact such as swimming.

The numeric aquatic life standards include chronic and acute values that are based on extensive laboratory studies including a wide variety of potentially affected species, a variety of life stages, and durations of exposure. Chronic aquatic life standards are protective of long-term exposure to a parameter. The protection afforded by the chronic standards includes reproduction, early life stage survival, and growth rates. In most cases the chronic standard is more stringent than the corresponding acute standard. Acute aquatic life standards are protective of short-term exposures to a parameter, and are not to be exceeded.

High quality waters are afforded an additional level of protection by the nondegradation rules (ARM 17.30.701 et. seq.,) and in statute (75-5-303 MCA). Changes in water quality must be "non-significant" or an authorization to degrade must be granted by the Department. However under no circumstance may standards be exceeded. It is important to note that waters that meet or are of better quality than a standard are high quality for that parameter, and nondegradation policies apply to new or increased discharges to that the water body.

Narrative standards have been developed for substances or conditions for which sufficient information does not exist to develop specific numeric state wide standards. The term "Narrative Standards" commonly refers to the General Prohibitions in ARM 17.30.637 and other descriptive portions of the surface water quality standards. The General Prohibitions are also called the "free from" standards; that is, the surface waters of the state must be free from substances attributable to discharges, including thermal pollution, that impair the beneficial uses of a water body. Uses may be impaired by toxic or harmful conditions (from one or a combination of parameters) or conditions that produce undesirable aquatic life. Undesirable aquatic life includes bacteria, fungi, and algae.

The standards applicable to the list of pollutants addressed in the St. Regis TPA are summarized one-by-one below.

3.3.2.1 Sediment Standards

Sediment (i.e., coarse and fine bed sediment) and suspended sediment are addressed via the narrative criteria identified in **Table 3-4.** The relevant narrative criteria do not allow for harmful or other undesirable conditions related to increases above naturally occurring levels or from discharges to state surface waters. This is interpreted to mean that water quality goals should strive toward a condition in which any increases in sediment above naturally occurring levels are not harmful, detrimental, or injurious to beneficial uses (see definitions in **Table 3-4**).

Table 3-4. Applicable rules and definitions for sediment related pollutants

Rule(s)	Standard
17.30.602(28)	"Sediment" means solid material settled from suspension in a liquid; mineral or organic solid material that is being transported or has been moved from its site of origin by air, water or ice and has come to rest on the earth's surface, either above or below sea level; or inorganic or organic particles originating from weathering, chemical precipitation or biological activity.
17.30.602(19)	"Naturally occurring" means conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil, and water conservation practices have been applied. Conditions resulting from the reasonable operation of dams in existence as of July 1, 1971 are natural.
17.30.602(24)	"Reasonable land, soil, and water conservation practices" means methods, measures, or practices that protect present and reasonably anticipated beneficial uses. These practices include but are not limited to structural and nonstructural controls and operation and maintenance procedures. Appropriate practices may be applied before, during, or after pollution-producing activities.
17.30.622(3) & 17.30.623(2)	No person may violate the following specific water quality standards for waters classified A-1 or B-1.
17.30.622(3)(f) & 17.30.623(2)(f)	No increases are allowed above naturally occurring concentrations of sediment or suspended sediment (except a permitted in 75-5-318, MCA), settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.
17.30.622(3)(d)	No increase above naturally occurring turbidity or suspended sediment is allowed in A-1 except as permitted in 75-5-318, MCA.
17.30.623(2)(d)	The maximum allowable increase above naturally occurring turbidity is 5 NTU for B-1 except as permitted in 75-5-318, MCA.
17.30.637(1)(a & d)	State surface waters must be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will: (a) settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines; (d) create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life.

3.3.2.2 Temperature Standards

In practical terms, the temperature standards address a maximum allowable increase above "naturally occurring" temperatures to protect the existing temperature regime for fish and aquatic life. Additionally, Montana's temperature standards address the maximum allowable rate at which temperature changes (i.e., above or below naturally occurring) can occur to avoid fish and aquatic life temperature shock.

For waters classified as A-1 or B-1, the maximum allowable increase over naturally occurring temperature (if the naturally occurring temperature is less than 67º Fahrenheit) is 1°F and the rate of change cannot exceed 2°F per hour. If the natural occurring temperature is greater than 67ºF, the maximum allowable increase is 0.5ºF (ARM 17.30.622(e) and ARM 17.30.623(e).

3.3.3 Reference Approach for Narrative Standards

When possible, a reference site approach is used to determine the difference between an impacted area and a "natural" or least impacted water body. The reference site approach is the preferred method to determine natural conditions, but, when appropriate reference sites are not easily found, modeling or regional reference literature values are used.

SECTION 4.0 WATER QUALITY TARGETS

4.1 Water Quality Targets and Supplemental Indicators

To develop a TMDL, it is necessary to establish quantitative water quality targets and supplemental indicators. This document outlines water quality targets for sediment/habitat and temperature impairments in the St. Regis TPA. TMDL water quality targets must represent the applicable numeric or narrative water quality standards that provide full support of all associated beneficial uses. For pollutants with established numeric water quality standards, the water quality standard is used directly as the TMDL water quality target. For pollutants with only narrative standards, the water quality target must be a measurable interpretation of the narrative standard. In the St. Regis TPA, sediment/siltation pollutants have narrative standards and will require the selection of appropriate TMDL water quality targets and supplemental indicators. Montana's temperature standards are described as a maximum allowable deviation from naturally occurring conditions. To interpret the temperature standard, additional water quality targets and supplemental indicators will be selected.

Since there is no single parameter that can be applied to provide a direct measure of beneficial use impairment associated with sediment and temperature, a suite of water quality targets and supplemental indicators have been selected to be used in combination with one another. The water quality targets are considered to be the most reliable and robust measures of the pollutant. The proposed supplemental indicators are typically not sufficiently reliable to be used alone as a measure of impairment. These are used as supplemental information, in combination with the water quality targets, to provide better definition of potential impairments exerted by a pollutant. In some cases when a number of supplemental indicators are exceeded concurrently, they may support conclusions that narrative standards are being exceeded and a TMDL or follow-up monitoring may be needed. When this is the case, a detailed rationale for the pollutant-impairment linkage will be provided.

As described in the one-by-one discussions of individual pollutants presented in the following paragraphs, there is a documented relationship between the selected water quality targets and beneficial use support, and sufficient reference data is available to establish a threshold value representing "naturally occurring" conditions where all reasonable land, soil, and water conservation practices are in place. In addition to having a documented relationship with the suspected impaired beneficial use, the water quality targets have direct relevance to the pollutant of concern. Exceedences of water quality targets (based on sufficient data) indicate water quality impairment. The water quality targets will be used to assess the ultimate success of future restoration efforts.

The supplemental indicators provide supporting and/or collaborative information when used in combination with the targets. Additionally, some of the supplemental indicators are necessary to determine if exceedences of water quality targets are the result of natural versus anthropogenic causes. However, the proposed supplemental indicators are often not sufficiently reliable to be used alone as a measure of impairment because (1) the cause-effect relationship between the supplemental indicator(s) and beneficial use impairments is weak and/or uncertain, (2) the supplemental indicator(s) cannot be used to isolate impairments associated with individual pollutants (e.g., differentiate between an impairment caused by excessive levels of sediment versus high concentrations of metals), or (3) there is too much uncertainty associated with the supplemental indicator(s) to have a high level of confidence in the result. In some cases a suite of supplemental indicators may point to a narrative standard that is likely not being attained.

4.2 Linking Pollutants to a Beneficial Use

The beneficial use impairment determinations presented in **Section 5.3** are based on a weight-of-evidence approach in combination with the application of best professional judgment. The weight-of-evidence approach is applied as follows. If none of the water quality targets are exceeded, the supplemental indicators are then investigated. If a combination of supplemental indicators suggests that narrative standards are exceeded, a TMDL may be written or more monitoring may be identified for future TMDL formation. If a target is exceeded, supplemental indicators are also investigated before it is automatically assumed that the exceedence represents human-caused impairment. This is also the case where the supplemental indicators assist by providing collaborative and supplemental information, and the weight-of-evidence of the complete suite of water quality targets and supplemental indicators is used to make the impairment determination. Ultimately, the weight of evidence approach is a tool to determine if narrative water quality standards are being met or exceeded.

4.3 Sediment

The term sediment is used in this document to refer collectively to several closely-related pollutant categories, including suspended sediment, stream channel geometry that can affect sediment delivery and transport, and sediment deposition on the stream bottom.

4.3.1 Effects of Sediment on Aquatic Life and Cold Water Fisheries

Erosion and sediment transport and deposition are natural functions of stream channels. Sediment deposition builds streambanks and floodplains through flooding. Riparian vegetation and natural in-stream barriers such as large woody debris, beaver dams, or overhanging vegetation help trap sediment and build channel and floodplain features. When these barriers are absent or excessive erosion is taking place due to altered channel morphology or riparian vegetation, excess sediment is likely deposited or transported. Coarse or fine sediment may impair use by depositing in critical aquatic habitat areas.

Increases in fine sediment have been linked to land management activities, and research has shown a statistically significant inverse relation between the amount of fine sediment <6.4 mm in spawning beds and successful salmonid fry emergence (Reiser and Bjornn 1979, Chapman and McLeod 1987, Weaver and Fraley 1991, McHenry et al. 1994, and Rowe et al. 2003). Successful emergence of bull trout and westslope cutthroat trout fry decreases as fine sediment increases (Weaver and Fraley 1991, 1993). Overall, there was 39-44% emergence success for bull trout and 34-39% emergence success for westslope cutthroat trout with 20-30% fines in gravels. Emergence success dropped to 26% as fine sediments approached 40% for both species (Weaver and Fraley 1993). Fry emergence studies indicate that increases in sediment within spawning areas these two species use will have a continuous increasing negative effect as fine sediment increases. This means that there is not a specific amount of sediment in fish spawning areas that can be used as a target because any increases in fine sediment will likely have negative impacts on fry emergence. Reference conditions that approximate naturally occurring sediment levels will be used for fish rearing targets.

The following sediment criteria are used in a weight of evidence approach. If any of the targets or indicators, alone or in combination indicate that Montana’s sediment related water quality standards are exceeded, a TMDL will be provided. Montana’s sediment standards are provided in **Section 3.3.2**.

4.3.2 Sediment Targets

The proposed water quality targets and supplemental indicators for sediment are summarized in **Table 4-1** and are described in detail in the paragraphs which follow.

Table 4-1. Sediment targets for the St. Regis River TPA

Water Quality Targets	Criteria
% fines ≤6.3 mm in McNeil core samples*	Mean of 4 samples/site ≤28%
Mean riffle stability index	>45 and <75
Pools/mile	B&C stream types with a bankfull width <20' wide : ≥77
	B stream types with a bankfull width >20'&<35' wide : ≥52
	B stream types with a bankfull width >35'&<45' wide: ≥29
	C stream types with a bankfull width >20'&<45' wide : ≥16
Grid-toss % surface fines <6mm in pool-tails outs	≤8.0
% of fine sediment <2mm in riffles based on pebble count	<20%
Supplemental Indicators	**Criteria**
Width/depth ratio	A stream types: ≤12
	B stream types: ≤23
	C stream types: ≤20
	St. Regis below Haugan: ≤30
LWD/mile	B&C stream types with a bankfull width <20' wide : ≥163
	B&C stream types with a bankfull width >20'&<35' wide : ≥112
	B&C stream types with a bankfull width >35' wide: ≥104
Sinuosity	≥1.2
Proper functioning condition (PFC) riparian assessment	"Proper Functioning Condition" or "Functional-at Risk" with an upward trend
Macroinvertebrates	Mountain MMI >63
	1.2>RIVPACS>0.80
Anthropogenic sediment sources	No significant sources present

**Applied only to St Regis River upstream of Saltese and to all listed tributary streams.*

4.3.2.1 Channel Morphology and Substrate Measurement Targets

McNeil Cores in Spawning Gravels
Spawning gravel composition in the St. Regis River and its tributaries was examined using McNeil core samples. McNeil core samples measure long-term changes in fine sediment in channel substrate independent of variation in annual runoff. Sample locations included 6 sites on the St. Regis River and 7 tributary sites, for a total of 13 sample sites. McNeil core samples were conducted in identified and potential spawning gravels located in pool tail-outs. Four McNeil core samples were collected at each location and a mean value was derived for each site.

Potential least-impacted sites included Ward, Deer, and Savenac Creeks which are described on the 2004 303(d) List as fully supporting their beneficial uses. A site on the South Fork Little Joe Creek was also chosen as a potential least-impacted site due to observed bull trout redds by Lolo National Forest fisheries biologists. South Fork Little Joe is not a reference watershed; this site is located above most of the road impacts observed in the South Fork Little Joe Watershed. While Savenac Creek is not listed as impaired, a high percent of fine sediment in both McNeil core samples and grid-toss samples, along with evidence of historic human impacts in the lower portions of the drainage, excluded it from consideration as a least-impacted site. Thus, Ward Creek, Deer Creek, and South Fork Little Joe Creek were used to develop water quality targets for McNeil cores. McNeil core samples from these three streams had a mean of 24.7% sediment finer than 6.3 mm in size. Mean values of 21.6, 24.8, and 27.8% finer than 6.3 mm were found in South Fork Little Joe, Ward, and Deer Creeks respectively (**AppendixA)**. The 75th percentile from these streams was 27.8% less than the 6.3 mm sediment size class. Reference condition investigations conducted in other TMDL planning areas, including Bobtail Creek, Blackfoot River headwaters, and the Grave Creek Watershed, all found similar levels of levels of fines in spawning redds. Thus, a water quality target of ≤28% finer than 6.3 mm is established as a water quality target for the St. Regis River upstream of Saltese and for tributaries within the St. Regis watershed (**Table 4-1**). If conditions are currently under 28%, then an adaptive management approach should be applied to assure that the percent fine sediment in spawning gravels does not exceed the existing level since increasing fine sediment in spawning gravel has a generally negative relationship with fry emergence.

Riffle Stability Index
The riffle stability index provides an estimate of sediment supply in a watershed. Kappesser (2002) found that riffle stability index values between 40 and 70 in B-channels indicate that a stream's sediment transport capacity is in dynamic equilibrium with its sediment supply. Values between 70 and 85 indicate that sediment supplies are moderately high, while values greater than 85 are suggestive of excessively sediment-loaded streams. The scoring concept applies to any streams with riffles and depositional bars. Riffle stability index values were determined primarily in C-channels in the St. Regis watershed. Riffle stability index values of 75 and greater were documented in managed subwatersheds within the St. Regis River drainage. Watersheds were considered to be "managed" if roads existed above a stream survey site. Other managed and unmanaged subwatersheds within St. Regis drainage produced riffle stability index values of between 46 and 75 (**Appendix B**). The results indicated that there was more mobile bedload in managed areas of the St. Regis watershed as compared to less developed stream segments. Riffle stability index values of zero were found in confined reaches of the St. Regis River and its

tributaries that resulted from proximity of hill slopes, encroachment by roads, and the presence of riprap and/or meander cutoffs. In these situations, the riffle stability index values indicated that the sediment transport capacity was in excess of the sediment supply. The lowest non-zero value (46) was measured in a least-impacted portion of the St. Regis River headwaters.

The riffle stability index water quality target for the St. Regis River and tributary watersheds is greater than 45 and less than 75 based on Kappesser's research, as well as local reference conditions for least-impacted stream segments (**Table 4-1**). These targets are applicable to all sections of river. However, stretches with extensive riprap may never develop gravel bars and may always have values of zero. Natural confinement may also lead to zero values.

Pool Frequency

Pool frequency varies based on the type of channel and the size of the stream. The majority of the St. Regis River downstream of Saltese can be described as a pool-riffle channel characterized by a sequence of bars, pools, and riffles (Montgomery and Buffington 1997). A pool-riffle channel is equivalent to the Rosgen C-type channel. Reaches described as Rosgen F-type channels currently resemble plane-bed channels. Plane-bed channels are characterized by long stretches of relatively featureless bed in which pools and bars form as the result of obstructions (Montgomery and Buffington 1997). These reaches are likely the result of channelization along the St. Regis River. Reaches upstream of Saltese and in the tributaries can be described as pool-riffle channels, step-pool channels, and cascades that would be expected to have greater pool frequencies (Montgomery and Buffington 1997).

An assessment of pool frequency was conducted utilizing the entire dataset from the St. Regis watershed. Based the entire dataset, there was a median of 112 pools per mile in B-type streams and 41 pools per mile in C-type streams within the St. Regis TPA. Pool frequency in Rosgen B-type streams ranged from 30 to 572 pools per mile at the 25th and 75th percentile respectively. Pool frequency in Rosgen C-type streams ranged from 13 to 153 pools per mile at the 25th and 75th percentile respectively. However, most of these streams have been modified to the extent that they probably do not represent appropriate reference conditions.

Instead, regional reference data was used for the development of pool frequency targets. Specifically, the Lolo National Forest (LNF) dataset for undeveloped streams, the Libby Ranger District of the Kootenai National Forest (KNF) reference dataset, and reference data collected during the Swan TMDL are used as applied in the Grave Creek TMDL (MDEQ 2005). An assessment of undeveloped streams on the LNF indicated Rosgen B stream types averaged 39 pools per mile, while Rosgen C stream types averaged 37 pools per mile. On the KNF, Rosgen B and C stream types between 10 and 20 feet wide ranged from 77 to 118 pools per mile at the 25th and 75th percentiles respectively. There was very little difference in pool spacing in these smaller channels. On the KNF, Rosgen B stream types between 20 and 32 feet wide ranged from 52 to 71 pools per mile at the 25th and 75th percentiles respectively, while C stream types between 20 and 32 feet wide ranged from 16 to 44 pools per mile at the 25th and 75th percentiles respectively. Thus, a target of at least 77 pools per mile for streams <20 feet wide is established for both Rosgen B and C stream types, while a pool frequency target of at least 52 pools per mile is established for B-type streams between 20 and 35 feet wide, based on the KNF reference dataset. In the Swan River TPA, Rosgen B and C stream types between 35 and 45 feet wide had a range of 29 to 47 pools per mile at the 25th and 75th percentiles respectively. Based on this dataset, a pool frequency target in channels between 35 and 45 feet wide of at least 29 pools per mile is established for B stream types. A pool frequency target of at least 16 pools per mile is established for C stream types between 20 and 45 feet wide.

For stream widths greater that 45 feet, a numeric target expressed as pools per mile is not established due to a lack of reference data. However, a pool frequency of at least two pools for each meander wavelength would be expected under natural conditions in meandering stream channels (C stream types), while step-pool channels (B stream types) would be expected to have more pools.

Percent Surface Fines
The U.S. Forest Service conducted 25 habitat surveys in "undeveloped" watersheds on the Lolo National Forest, which were defined as roadless upstream of the survey site, between 1989 and 1995. A 49-point grid-toss sample based on methods developed by Kramer (1991) was conducted over the entire stream reach, including both pools and riffles (Riggers et al. 1998). Based on this assessment, it was determined that least-impacted conditions for percent surface fines for streams draining metasedimentary geologies on the Lolo National Forest averaged 7.6% in B channels and 8.0% in C stream channels at the reach scale (Riggers et al. 1998).

The percent surface fines less than 6 mm was assessed near each McNeil core sample site in the St. Regis watershed using a 49-point grid. This assessment found that the percent surface fines data collected using the grid-toss method was correlated with data collected using the McNeil core sampler. Exceptions include Deer Creek (which had a fairly low McNeil core value, but the second highest grid-toss value) and Twelvemile Creek (which had one of the higher McNeil core values and a fairly low grid-toss value). Excluding these two sites, the other McNeil core samples sites with results <28% finer than 6.3mm, which is the established water quality target, all had grid-toss values of <8% finer than 6 mm. Thus, a grid-toss value of ≤8% finer than 6 mm is established as a supplemental indicator for the percent of surface fines in pool tail-outs in the St. Regis TPA. This value will also be used to assess existing data collected in lateral scour pools.

A supplemental indicator of <20% of the substrate finer than 2 mm in riffles as collected with a Wolman pebble count is established based on the requirements of aquatic macroinvertebrates (Relyea, 2000). However, this value may be reduced once additional pebble count data from reference streams within the St. Regis TPA is collected. Regional reference data from the Yaak (EPA and KNF unpublished data as reported in the Grave Creek TMDL) indicated that the percent of fine sediment <6.35mm in riffles based on pebble counts had mean values ranging from 10-13% in Rosgen B3, B4, C3, and C4 streams. Thus, it is anticipated that the future supplemental indicator value for the amount of fine sediment <2mm could be in the 10-20% range.

4.3.2.2 Supplemental Indicators

Width/Depth Ratio
The bankfull width to average bankfull depth ratio (W/D ratio) of the stream channel is a fundamental aspect of channel morphology and provides a measure of channel stability. Changes in the width/depth ratio can be used as an indicator of change in the relative balance between the sediment load and the transport capacity of the stream channel. As the W/D ratio increases, streams become wider and shallower. An increase in the width/depth ratio also suggests an excess of sediment that the stream can not transport easily, usually coarse sizes (MacDonald et al. 1991). The depth of the stream channel decreases as sediment accumulates, which is compensated for by an increase in channel width as the stream attempts to regain a balance between sediment load and transport capacity. Accelerated bank erosion and an increased sediment supply often accompany increases in the width/depth ratio (Rosgen 1996).

Riggers et al. (1998) suggested that W/D ratios should be between 3 and 12 for A-type stream channels, between 12 and 22 for B-type stream channels, and between 10 and 33 for C-type channels located in metasedimentary geologies on the Lolo National Forest (**Table 4-2**). Although, the Riggers study applied normal statistics to a non-normal distributed data which was skewed toward the higher end of the distribution. The suggested high end of the Riggers et al. (1998) reference W/D ratios are thus likely too high because of statistical errors, especially for the C-type streams. A smaller reference dataset from the Kootenai National Forest indicates that reference W/D ratios should be slightly lower than the Lolo National Forest data analysis. Width/Depth ratios target levels will be based on these two studies but using results based on nonparametric statistics.

Supplemental indicator values for width/depth ratios will be ≤23 for B-type streams, and ≤20 for C-type streams in the St. Regis TPA. An exception to these applications will be the St. Regis River below Haugan. Width to depth ratios naturally increase when stream order increases. St. Regis Rivers W/D ratio indicator below Haugan will be set at ≤30 to account for this natural variability.

Table 4-2: Width-to-Depth Ratio Reference Sources and Results

Data Source	Stream Types & Other Stratification	Suggested Reference Condition W/D Ratios
Lolo National Forest Reference Streams (Riggers, et al., 1998) (recommended ranges based on reference data sets)	B3 & B4 C3 & C4	12 – 22 10 – 33
Kootenai National Forest Reference Data	B3 (stream widths 18 ± 9 ft) B4 (stream widths 13 ± 4 ft) C3 (stream widths 26 ± 4 ft) C4 (stream widths 15 ± 3 ft)	20.9 ± 9.0 (n = 34) 19.4 ± 6.9 (n = 22) 16.0 ± 7.4 (n = 4) 14.7 ± 3.2 (n = 3)

Large Woody Debris
Large woody debris plays a significant role in the creation of pools, especially in smaller stream channels. Hauer et al. (1999) observed that single pieces of large woody debris situated perpendicular to the stream channel or large woody debris aggregates form the majority of pools in a study conducted in northwestern Montana.

An assessment of large woody debris per mile was conducted utilizing the entire dataset from the St. Regis watershed. Based the entire dataset, there was a median of 111 pieces of large woody debris per mile in B-type streams and 73 pieces of large woody debris per mile in C-type streams within the St. Regis TPA. Large woody debris in Rosgen-B type streams ranged from 30 to 602 pieces per mile at the 25th and 75th percentiles respectively. Large woody debris in Rosgen C-type streams ranged from 29 to 203 pieces per mile at the 25th and 75th percentiles respectively. In addition, the three reaches of the St. Regis River assessed as “proper functioning condition” had a mean of 104 pieces per mile. However, most of these streams have been modified to the extent that they probably do not represent appropriate reference conditions.

Instead, regional reference data was used for the development of large woody debris targets. Specifically, the Lolo National Forest (LNF) dataset for undeveloped streams, the Libby Ranger District of the Kootenai National Forest (KNF) reference dataset, and reference data collected during the Swan TMDL were used as applied in the Grave Creek TMDL (MDEQ 2005). Active large woody debris was found in undeveloped streams on the LNF at an average of 156 pieces per mile in 3rd and 4th order streams (Riggers et al. 1998). For streams ranging from 10 to 20 feet wide on the KNF, large woody debris was found to range from 163 to 371 pieces per mile at the 25th and 75th percentiles respectively when Rosgen B and C stream types were combined. For streams ranging from 20 to 35 feet wide on the KNF, large woody debris was found to range from 112 to 443 pieces per mile at the 25th and 75th percentiles respectively when Rosgen B and C stream types were combined. For Rosgen B and C streams ranging from 35 to 45 feet in the Swan TPA, large woody debris ranged from 104 to 210 pieces per mile at the 25th and 75th percentiles respectively. Thus, a large woody debris target of at least 163 pieces per mile is established for Rosgen B and C stream types between 10 and 20 feet wide and at least 112 pieces per mile for Rosgen B and C stream between 20 and 35 feet. A supplemental indicator of at least 104 pieces per mile is established for streams wider than 35 feet (**Table 4-1**).

Sinuosity
Extensive channelization along the mainstem of the St. Regis River has reduced the ability of the river to access the floodplain. A supplemental indicator value for sinuosity of at least 1.2 is established for the mainstem of the St. Regis River and the listed tributaries based on work by Rosgen (1996) (**Table 4-1**). This supplemental indicator is not applicable in naturally confined valley types that can not support this high of stream sinuosity.

Riparian Condition
Interactions between the stream channel and the riparian vegetation along the stream banks are a vital component in the support of the beneficial uses of cold water fish and aquatic life. Riparian vegetation provides organic material used as food by aquatic organisms and supplies large woody debris that influences sediment storage and channel morphology. Riparian vegetation

provides shading, cover, and habitat for fish. Extensive riparian vegetation reduces temperature fluctuations and stream bank erosion.

The Proper Functioning Condition (PFC) method is a qualitative procedure for "assessing the physical functioning of riparian-wetland areas" (Prichard 1998). The hydrologic processes, riparian vegetation characteristics, and erosion/deposition capacities of streams are evaluated for a selected stream reach. The final rating is a professional judgment call based on responses to a series of yes/no questions. The possible ratings for a reach are "proper functioning condition" (PFC), "functional - at risk" (FAR), or "non-functional" (NF). Alternative riparian assessment techniques that employ similar methodologies, such as the DEQ Stream Reach Assessment, may also be applied. For listed streams in the St. Regis TPA, riparian areas should in proper functioning condition or in functioning-at-risk conditions but showing an improving trend.

Macroinvertebrates

Siltation exerts a direct influence on benthic macroinvertebrates assemblages through several mechanisms. These include limiting preferred habitat for some taxa by filling in interstices or spaces between gravel. In other cases, fine sediment limits attachment sites for taxa that affix to substrate particles. Macroinvertebrate assemblages respond predictably to siltation with a shift in natural or expected taxa to a prevalence of sediment tolerant taxa over those that require clean gravel substrates. Macroinvertebrate bioassessments scores are an assessment of the macroinvertebrate assemblage at a site, and are used by the DEQ to evaluate impairment condition and beneficial use support. The advantage to these bioindicators is that they provide a measure of support of associated aquatic life, an established beneficial use of Montana's waters.

In 2006, DEQ adopted impairment thresholds for bioassessment scores based on two separate methodologies. The Multi-Metric Index (MMI) method assesses biologic integrity of a sample based on a battery of individual biometrics. The River Invertebrate Prediction and Classification System (RIVPACS) method utilizes a probabilistic model based on the taxa assemblage that would be expected at a similar reference site. Based on these tools, the DEQ adopted bioassessment thresholds that were reflective of conditions that supported a diverse and biologically unimpaired macroinvertebrate assemblage, and therefore a direct indication of beneficial use support for aquatic life.

The MMI is organized based on the different ecoregions within Montana. Three MMIs are used to represent the various Montana ecoregions: Mountain, Low Valley, and Plains. Each region has specific bioassessment threshold criteria that represent full support of macroinvertebrate aquatic life uses. The St. Regis watershed falls within the Mountain MMI region. The MMI score is based upon the average of a variety of individual metric scores. The metric scores measure predictable attributes of benthic macroinvertebrate communities to make inferences regarding aquatic life condition when pollution or pollutants affect stream systems and in-stream biota. For the Multi-Metric Index, individual metric scores are averaged to obtain the final MMI score, which ranges between 0 and 100. The impairment threshold is 63 for the Mountain MMI. This value is established as a supplemental indicator for sediment impairments in the St. Regis TPA. The impairment threshold (10^{th} percentile of the reference dataset) represents the point where DEQ technical staff believed macroinvertebrates are affected by some kind of stressor that is contributing to impairment (e.g. loss of sensitive taxa).

The RIVPACS model compares the taxa that are expected at a site under a variety of environmental conditions with the actual taxa that were found when the site was sampled. The RIVPACS model provides a single dimensionless ratio to infer the health of the macroinvertebrate community. This ratio is referred to as the Observed/Expected (O/E) value. Used in combination, the results suggest strong evidence that a water body is either supporting or non-supporting its aquatic life uses for aquatic invertebrates. The RIVPACS impairment threshold for all Montana streams is any O/E value <0.8. However, the RIVPACS model has a bidirectional response to nutrient impairment. Some stressors cause macroinvertebrate populations to decrease right away (e.g. metals contamination) which causes the score to decrease below the impairment threshold of 0.8. Nutrient enrichment may actually increase the macroinvertebrate population diversity before eventually decreasing below 0.8. An upper limit was set to flag these situations. The 90^{th} percentile of the reference dataset was selected (1.2) to account for these situations and any value above this score is defined as impaired unless specific circumstances can justify otherwise. However, RIVPACS scores >1.0 are considered unimpaired for all other stressor types. A supplemental indicator value RIVPACS score of >0.80 and <1.2 is established for sediment impairments in the TPA. A score of greater than 1.2 does not necessarily indicate a problem but when combined with other data may present support for nutrient impacts.

Anthropogenic Sediment Sources

In order to make accurate impairment decisions, it is important to consider all potentially significant pollutant sources. Doing so helps differentiate between natural and human caused conditions. If target/indicator values are exceeding the proposed threshold values, yet no significant human sources exist, then natural condition may be the cause. Additionally, as a basic part of watershed restoration and protection, all significant controllable human caused pollutant sources should be addressed. The goal of the St. Regis TMDL project is that no significant controllable human caused sediment sources should exist in the watershed.

4.4 Temperature

Canopy density, stream channel geometry, and temperature thresholds that relate to the most sensitive beneficial use, along with the administrative rules of Montana will be applied as water quality goals and supplemental indicator criteria for stream segments listed as impaired due to thermal modifications in the St. Regis TPA. Special temperature considerations are warranted for the bull trout and the westslope cutthroat trout, which are both found in the St. Regis TPA. Temperatures that support these species are used for estimating if state temperature standards are exceeded in the streams of interest because these species are or were once present in the St. Regis watershed. Temperatures that support these species may be used to help estimate naturally occurring temperature conditions along with temperature influencing factors such as shade, groundwater influences, channel geometry, stream discharge, and stream aspect when a model is not used to complete this task. The temperature thresholds that support these species are not provided as absolute targets because the streams in the St. Regis watershed may not naturally have the ability to support these temperatures.

4.4.1 Effects of Increased Temperatures on Aquatic Life and Cold Water Fisheries

Factors influencing stream temperature include solar radiation, the canopy density of riparian vegetation, channel morphology, stream discharge, and stream aspect. Interactions between the stream channel and the riparian vegetation along the stream banks are a vital component in the support of the beneficial uses of coldwater fisheries and aquatic life. Shade provided by riparian vegetation decreases the amount of solar radiation reaching the channel and reduces stream temperature fluctuations. Native fish in this area include cutthroat trout and bull trout. These species are likely the most sensitive use regarding stream temperatures.

4.4.2 Temperature Targets

The proposed water quality targets and supplemental indicators for temperature are summarized in **Table 4-3** and are described in detail in the paragraphs which follow. These targets apply to the St. Regis River, Big Creek, and Twelvemile Creek, which are the three water bodies in the St. Regis TPA that require TMDLs for temperature/thermal modifications. Although, the allocation section of the St. Regis temperature TMDL will effectively call for a watershed wide application of the canopy density criteria for thermal load allocations to tributaries.

Table 4-3. Temperature targets for the St. Regis River TPA

Water Quality Target	Criteria
Montana Water Quality Standard for Temperature	The maximum allowable increase over naturally occurring temperature (if the naturally occurring temperature is less than 67º Fahrenheit) is 1°F and the rate of change cannot exceed 2°F per hour. If the natural occurring temperature is greater than 67ºF, the maximum allowable increase is 0.5ºF (ARM 17.30.622(e), ARM 17.30.623(e)).
Meet the Water Temperature Target Above or Meet All of the Surrogate Targets Below:	
Canopy density	≥60% on St. Regis River ≥65% in all tributaries where shrub canopy naturally dominates stream banks. ≥90% in headwater zones where trees naturally dominate the canopy along stream banks.
Channel width/depth ratio	A stream types: ≤12 B stream types: ≤23 C stream types: ≤20
Supplemental Indicator (not a target)	
Seasonal Maximum, 7-Day Average of Daily Maximum Temperatures (7DADMT)	St. Regis River downstream of Saltese: ≤59ºF St. Regis River upstream of Saltese and all tributary streams: ≤54ºF

4.4.4.2 Temperature Targets

Montana's Water Quality Standard

Water quality targets for temperature are established at a level necessary for the long term viability of the bull trout while also considering the state water quality standards. The Administrative Rules of Montana specify that waters of Montana classified as A-1 or B-1 by the State of Montana, a 1ºF maximum increase above naturally occurring water temperature is allowed within the range of 32-66ºF; within the naturally occurring range of 66-66.5ºF, no discharge is allowed which will cause the water temperature to exceed 67ºF; and where the naturally occurring water temperature is 66.5ºF or greater, the maximum allowable increase in water temperature is 0.5ºF (ARM 17.30.622 (3)(e), ARM 17.30.623 (2)(e)). Temperature monitoring and modeling indicate that naturally occurring stream temperatures in the St. Regis TPA likely fall within the coolest of the ranges specified by ARM 17.30.622 (3)(e) (32F to 66F) and thus the maximum allowable increase above naturally occurring temperatures is 1ºF . This rule is adopted as one of the water quality targets for temperature for all streams in the St. Regis TPA.

Temperature, shade, and stream flow monitoring, along with associated temperature modeling was used to estimate how stream temperatures deviate from naturally occurring levels for two tributaries. However, because the modeling was not completed for the whole watershed, the naturally occurring temperature range in the St. Regis River is not understood as well as in modeled tributaries. Because modeling was not feasible at a watershed scale, a suite of surrogate targets is used for the St. Regis River along with inferences from modeled areas for comparison to Montana's water temperature standard.

As described above, Montana's water quality standard for temperature addresses a maximum allowable increase above the "naturally occurring" temperature to protect the existing temperature regime for fish and aquatic life (see **Section 3.3.2.4**). For Big and Twelve Mile Creeks, the QUAL2K model was used to assess existing stream temperatures relative to the Montana standard. The QUAL2K model was used to determine if anthropogenic disturbances within the watershed have increased the water temperature above the "naturally occurring" level. Stream temperature and riparian shading data collected in the summer of 2006 was used to calibrate the QUAL2K model for existing conditions. The potential to reduce stream temperatures by increasing riparian shading and in-stream flows through the application of all reasonable land, soil, and water conservation practices was then modeled to assess temperature impairments and develop TMDL load allocations. The relationship between anthropogenic disturbance and water quality impairments as described in ARM 17.30.623(e) was evaluated with the following definitions since almost all water temperature measurements were below 66°F, and temperatures found above 66°F are not likely to be naturally occurring:

> If simulated stream temperatures derived from the model using the existing riparian shade data deviate by <u>less than 1ºF</u> from stream temperatures derived using the potential riparian shade, then anthropogenic sources are assumed to not be causing or contributing to violations of the A-1 and B-1 water temperature standards and the stream <u>is not</u> considered impaired due to anthropogenic (or anthropogenically induced) thermal modifications.

> If simulated stream temperatures derived from the model using the existing riparian shade data deviate by greater than 1ºF from stream temperatures derived using the potential riparian shade, then anthropogenic sources are assumed to be causing or contributing to violations of the relevant A-1 and B-1 water temperature standards and the stream is considered impaired due to anthropogenic thermal modifications.

Although the QUAL2K model provides a reasonable method of interpreting the Montana water quality standard for temperature in the listed tributary streams, its ability to predict accurately temperature differences of less than 1ºF has not been fully evaluated. For this reason, the surrogate target suite should also be included as performance measures for Big and Twelvemile Creeks. Supporting temperatures of sensitive fish species should also be considered but modeling indicated some areas of these streams may not naturally support these temperatures during all timeframes.

Inferences from the modeling effort on the tributaries to the St. Regis River will help support conclusions about naturally occurring temperatures on the St. Regis River. Surrogate targets comparisons and comparisons to tributary modeling will be used to loosely estimate impairment based on Montana's temperature standard.

Canopy Density

Canopy density on stream banks is an indictor of the amount of stream-side shading provided by the riparian vegetation. Lower canopy densities allow more direct radiation to reach the stream channel, which leads to increased stream temperatures and greater fluctuations in stream temperature both daily and seasonally. Decreasing the amount of forest or shrub cover can increase the incident solar radiation, which leads to an increase in peak summer temperatures.

Least impacted conditions along the St. Regis River indicate overall canopy density along the stream banks at the sub-reach scale ranges from 60-65%, with canopy density along the left bank ranging from 45-60% and canopy density along the right bank ranging from 60-75%. Thus, a surrogate target value for canopy density of ≥60% is proposed for the St. Regis River. However, potential conditions may need to be adjusted locally along the St. Regis River based on the proximity of the interstate, since some reaches will not be able to attain target criteria due to road encroachment.

Tributary riparian canopy density and associated effective shade conditions were assessed in detail during source assessment work in Big and Twelvemile creeks. Reference conditions in steeper stream channel, naturally forested streambank conditions were 90% or better. In least impacted and reference areas were shrub growth dominated streambanks an average of 65% canopy density over the stream was measured.

Width/Depth Ratio

Lower channel bankfull width to average bankfull depth ratios (W/D ratios) are associated with the presence of deep pools that provide better thermal protection for cold water fish (Riggers et al.1998). A decrease in depth increases the thermal exchange rate with air (Beschta and Platts 1986), while an increase in width allows greater inputs of solar radiation, which can lead to higher stream temperatures. Width/depth ratios used as supplemental indicator criteria for sediment impairments (**Section 4.3.2.1**) are also applied as supplemental indicator criteria for temperature impairments. Most temperature models indicate that stream channel dimension is the least sensitive factor when considered along side shading and stream flow conditions. Even so, in some circumstances it is a significant contributing factor for heating in-stream water.

Stream Discharge and Point Sources
The St. Regis watershed has no appreciable irrigation diversions that would significantly reduce the thermal assimilative capacity of streams. There are no permanent point sources that would provide significant heat in the St. Regis watershed. Therefore no surrogate targets are proposed for these influences on temperature.

Highest 7-Day Average of the Daily Maximum Temperature (supplemental indicator)
Special consideration is warranted in the St. Regis River TPA for bull trout, which are listed as threatened under the Endangered Species Act (USFWS 1999). Bull trout have some of the lowest "upper thermal limits" and growth optima of North American salmonids. Bull trout experience optimum growth at 55.7ºF (13.2ºC) (Selong et al. 2001) under laboratory conditions. A study conducted in Idaho found bull trout selected the coldest water available when temperatures ranged from 46.4-59.0ºF (8-15ºC) (Bonneau and Scarnecchia 1996). A model developed by Dunham et al. (2003) predicts less than 50% occurrence of bull trout until maximum daily temperatures decline to approximately 57.2-60.8ºF (14-16ºC). A high probability of occurrence (75%) occurs when maximum daily temperatures decline to approximately 51.8-53.6ºF (11-12ºC). Bull trout are most likely to use waters with maximum daily temperatures less than or equal to 53.6ºF (12ºC) (Dunham et al. 2003). A review of bull trout temperature requirements as summarized by the U.S. Fish and Wildlife Service (USFWS) in "A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Watershed Scale" (1998) is excerpted below:

> *Stream temperatures…may be particularly important characteristics of suitable habitats. Bull trout have repeatedly been associated with the coldest stream reaches within basins. Goetz (1994) did not find juvenile bull trout in water temperatures above 12.0°C. The best bull trout habitat in several other Oregon streams was where water temperature seldom exceeded 15°C (Buckman et al. 1992; Ratliff 1992; Ziller 1992). Temperature also appears to be a critical factor in the spawning and early life history of bull trout. Bull trout in Montana spawned when temperatures dropped below 9-10°C (Fraley and Shepard 1989). McPhail and Murray (1979) reported 9°C as the threshold temperature to initiate spawning for British Columbia bull trout. Temperatures fell below 9°C before spawning began in the Metolius River, Oregon (Riehle 1993). Survival of bull trout eggs varies with water temperature (McPhail and Murray 1979). They reported that 0-20%, 60-90%, and 80- 95% of the bull trout eggs from British Columbia survived to hatching in water temperatures of 8-10°C, 6°C, and 2-4°C respectively. Weaver and White (1985) found that 4-6°C was needed for egg development for Montana bull trout.*

Stream temperature data collected in the St. Regis watershed between 2001 and 2003, and in 2006 by the U.S. Forest Service and MDEQ reported the number of days where the temperature exceeded 50ºF (10ºC), 59ºF (15ºC), and 70ºF (21ºC). These data are presented in greater detail in

Section 5.0 of this report, as well as in **Appendices C and D**. The 50ºF value represents conditions conducive to bull trout spawning, while the 59ºF value represents conditions conducive to Bull trout rearing, both of which correspond to the “Functioning at Risk” level in the USFWS matrix (**Table 4-4**). Temperature data collection efforts in the St. Regis TPA have focused on characterizing maximum summer temperatures and no data are available from the fall, winter, and early spring when incubation and spawning occur. For this reason, fishery impact discussion in this document in relation to bull trout is limited to the rearing and migration life history stages, USFWS temperature guidelines from the “Functioning Appropriately” column of **Table 4-3** were used to assist with determining naturally occurring although they are not an absolute target since many streams may not naturally be able to support these specific temperatures year round. Montana’s temperature standard is based on an allowable increase above naturally occurring stream temperatures and assessing the hottest weather periods will provide protection during other timeframes due to the nature of heat sources in the watershed.

While the USFWS has determined that these temperatures are required by bull trout at various stages of their life history, the extent to which such temperatures were historically found in streams of the St. Regis TMDL is currently uncertain. It is possible that in some streams or sections of streams, naturally occurring temperatures periodically exceeded the levels recommended by USFWS under natural background conditions. Modeling conducted in support of temperature TMDLs in the St. Regis TPA and discussed in greater detail in (**Appendix C**) provides an estimate of the extent to which current temperatures have departed from naturally occurring temperatures. The use of temperature thresholds which support bull trout propagation will only be used as supporting evidence for estimated natural background temperatures and are not an absolute target.

A water quality supplemental indicator is established for the St. Regis River based on the 7 day average of the daily maximum temperature recorded over the warmest week of the season. This is known as the 7-Day Average of the Daily Maximum Temperature (7DADMT) and describes the annual peak in the 7-day average of the daily maximum temperatures. The 7DADMT usually occurs between mid-July and mid-August in Montana streams. Based on information collected on bull trout temperature requirements as summarized by the USFWS (1998), along with work conducted by Dunham et al. (2003), a water temperature indicator of ≤54ºF (12ºC) 7DADMT is set for the mainstem of the St. Regis River upstream of Saltese (**Table 4-4**). This temperature target is geared toward protecting bull trout rearing in the headwaters of the St. Regis River. A water temperature indicator of ≤59ºF (15ºC) 7DADMT is set for the middle and lower mainstem of the St. Regis River downstream of Saltese. This temperature indicator is geared toward assuring the St. Regis River is a suitable migration corridor for bull trout. These use-based temperature indicators are not targets because modeling on a number of tributaries indicates these temperatures may not be naturally feasible. Also, two of the reference tributaries with north facing watersheds do not always meet these temperature thresholds, although they come close.

Table 4-4. U.S. Fish and Wildlife Service matrix for assessing temperature impacts to bull trout (modified from USFWS 1998)

	Life History Stage	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
7 day average maximum temperature	**Incubation (Fall, Winter, Early Spring)**	2-5ºC (35.6-41.0ºF)	<2ºC or >6ºC (<35.6ºF or >42.8ºF)	<1ºC or >6ºC (<33.8ºF or >42.8ºF)
	Spawning (Fall)	4-9ºC (39.2-48.2ºF)	<4ºC or >10ºC (<39.2ºF or >50.0ºF)	<4ºC or >10ºC (<39.2ºF or >50.0ºF)
	Rearing (Year Round)	4-12ºC (39.2-3.6ºF)	<4ºC or >13-15ºC (<39.2ºF or >55.4-59.0ºF)	>15ºC (>59ºF)
	Migration (Year Round)	never exceed 15ºC (59ºF)	sometimes exceed 15ºC (59ºF)	regularly exceed 15ºC(59ºF)

Temperature Target Application

Consideration of targets and supplemental indicators may differ slightly with the amount of data available for the stream of concern but a general approach for applying temperature targets and indicators was followed. Generally, the first consideration was to evaluate if temperature conditions are above the 54ºF or 59ºF depending on anticipated fishery use. This assessment utilized a continuous temperature data set collected during the warmest timeframe of the year. If the applicable temperature threshold is met, the most sensitive uses are likely met. If these temperature thresholds are not met, the shade and geomorphologic conditions should be investigated. If these surrogate target thresholds are met then naturally occurring temperature conditions are likely occurring and no temperature TMDL is needed. If shade and geomorphic targets are not met and it is anticipated or shown via modeling that >1ºF variation has been caused, then the stream is impaired. If impaired, as watershed conditions approach surrogate targets, additional modeling or other analysis can be performed to adjust these targets as necessary to ensure ultimate compliance with the WQ standard, which is the primary target in **Table 4-3**.

SECTION 5.0 EXISTING CONDITIONS AND STANDARDS COMPLIANCE

This section presents summaries and evaluations of all available water quality data for St. Regis TPA water bodies appearing on the Montana 1996 and subsequent 303(d) Lists. The weight of evidence approach described earlier in **Section 4.2**, using a suite of water quality targets and supplemental indicators, has been applied to verify and/or reconsider each of the 1996 listed water quality impairments. Supporting documentation is provided on a water body-by-water body basis.

5.1 Big Creek

The 1996 303(d) List reported Big Creek from the East and Middle Forks to the mouth was threatened for coldwater fisheries uses. The probable cause of impairment was thermal modifications. Probable sources of impairment included highway/road/bridge construction and silviculture. In 2006 Big Creek was listed as partially supporting aquatic life and coldwater fisheries. The probable causes of impairment include sedimentation/siltation and water temperature. Probable sources of impairment include channelization, loss of riparian habitat, and streambank modifications/destabilization.

5.1.1 Sediment

An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described Big Creek as “functioning at unacceptable risk” due to sediment. The Big Creek watershed was identified as having a road density of 2.5 miles/mile^2, with 37% of the streams having roads within 300 feet of the banks, a third of which are within 125 feet of the stream (Hendrickson and Cikanek 2000).

In August 2001, DEQ performed physical, chemical, and biological water quality assessments at two sites on Big Creek. The upper sample site was just below the confluence with the West and East forks, while the lower site was approximately a half mile above the mouth. The assessments included field measurements, photo documentation, a riparian survey, sampling for aquatic insects and algae, and water column measurements.

Based on the 2001 assessment, DEQ reported the upper assessed site was a Rosgen B3 stream type with a width/depth ratio of 16.7 and an entrenchment ratio of 2 based on an assessment in 2001, which is meeting the supplemental indicator width/depth value of ≤22 for Rosgen B-type streams. The percent of sediment <2mm was meeting the preliminary supplemental indicator value of <20% at both sites, with a value of 2.8% at the upper site and 0% at the lower site. The upper site was rated as “at risk” from the perspective of riparian integrity. Notations were made about channel downcutting, a lack of old age willow stands, and inadequate material for energy dissipation (i.e. woody debris). Field notes indicated that there was limited fish habitat. The lower site was also rated as “at risk” from the perspective of riparian integrity. Notations were made that the channel had been rerouted due to erosion and that the new channel lacked diverse and stabilizing riparian vegetation. Riparian disturbance was indicated by the presence of noxious weeds.

In 2002 and 2003, physical measurements were performed on Big Creek by USFS and DEQ to quantify existing conditions relative to sediment related impairments. A brief review of the results is presented below. Additional information can be found in **Appendix B.**

Sediment impairments in the mainstem of Big Creek were expressed by high riffle stability index values, slightly excessive fine sediment in lateral scour pool tails, and potentially over-widened channel conditions. A riffle stability index value of 85 exceeded the water quality target of <75, suggesting excess sediment loads between the three forks area and the confluence (**Table 5-1**). The percent of fine sediment <2mm in riffles remained below the preliminary supplemental indicator value of <20% with 3.1% and 5.0%. A percent surface fines value of 8.8 in lateral scour pools slightly exceeded the supplemental indicator criteria of ≤8%. Bankfull widths of 36.1, 41.0, and 60.3 feet along the mainstem suggest a somewhat overwidened condition; an appropriate bankfull width for this reach is more likely in the range of 20-45 feet, for which the pool frequency target is ≥16 pools per mile. Two pool frequency measures 55 and 45 were above the targeted pools per mile. Both of these measurements suggest that the pool frequency target is currently being met. Large woody debris per mile was meeting the supplemental indicator criteria of at least 104 pieces/mile for streams at least 35 feet wide with a value of 329 pieces/mile. The channel sinuosity was 1.2, which meets supplemental indicator criteria.

The water quality target of ≤28% sediment less than 6.3 mm was exceeded with a McNeil core value of 39.2% in West Fork Big Creek just upstream of the confluence with East Fork Big Creek and the formation of the Big Creek mainstem, while the grid-toss PSF accompanying the McNeil core averaged 11%, which exceeds the target value of ≤8%. These two measurements are not directly applicable to Big Creek, but do suggest that the West Fork Big Creek is a potential source of sediment to the mainstem of Big Creek. The fine sediment measure in Big Creek was slightly over the target McNeil Core samples taken at a site approximately 2 miles upstream of the mouth in 2003 had an average percent fines less than 6.3 mm of 39.2, well in excess of the target of ≤28%. Over widened channel conditions on Big Creek may also contribute to a situation where the stream channel is not efficiently moving sediments.

Table 5-1. Big Creek physical assessment data

<table>
<tr><th>Survey Reach</th><th>Bankfull Width</th><th>Width/ Depth Ratio</th><th>Stream Type</th><th>Grid-toss % PSF Lateral Scour Pools (mean)</th><th>Pebble Count % Surface Fines <2mm in Riffles</th><th>McNeil Core % Surface Fines <6.3mm</th><th>Sinuosity</th><th>RSI</th><th>Pools/ Mile</th><th>LWD/ Mile</th></tr>
<tr><td>LNF Hydro 3 (Mainstem)</td><td>41.0</td><td>24.1</td><td>C3</td><td>8.8</td><td>5</td><td></td><td>1.2</td><td>85</td><td>55</td><td></td></tr>
<tr><td>LWC XS1(Mainstem)</td><td>36.1</td><td>18.1</td><td>C4</td><td rowspan="2"></td><td rowspan="2">3.1</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">45</td><td rowspan="2">329</td></tr>
<tr><td>LWC XS2(Mainstem)</td><td>60.3</td><td>31.7</td><td>C4</td></tr>
<tr><td>Lower West Fork</td><td></td><td></td><td></td><td>11.4</td><td></td><td>38.6</td><td></td><td></td><td></td><td></td></tr>
</table>

5.1.2 Macroinvertebrates

Macroinvertebrate data were collected at two sites in Big Creek in 2001. At site C04BIGCR01, the Mountain MMI was 72.4, meeting the supplemental indicator value of >63 for impairments, while the RIVPACS O/E score of 0.75 just failed to meet the supplemental indicator value of 1.2>RIVPACS>0.8. At site C04BIGCR02, the Mountain MMI was 76.9, meeting the supplemental indicator value of >63, and the RIVPACS O/E score was 0.96, meeting the supplemental indicator value of 1.2>RIVPACS>0.8.

5.1.3 Periphyton

The 2001 periphyton bioassessments showed good biological integrity at both sites. At the upper site, sample results suggested the potential for elevated organic loading and nutrient enrichment (Bahls 2002). These results may be due an upstream beaver dam complex.

5.1.4 Fish Populations

The Montana Interagency Stream Fishery database rated Big Creek as “average” relative to its suitability for trout residence, spawning, and rearing. Natural impairments cited include temperature, low nutrients, and low amounts of aquatic invertebrates, while road construction and logging practices were listed as activities influencing the fishery. The trend for aquatic habitat quality was rated as “static” and aesthetics were rated as “average” (MFWP 1985). Recent fishery investigation indicates that brook trout and cutthroat trout are the predominant game fish species present (pers. com. Knotek). The overall habitat and resource value assigned to Big Creek was described as “outstanding” (MFISH 2004).

An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described bull trout and westslope cutthroat trout populations as “depressed” in Big Creek (Hendrickson and Cikanek 2000). A limited survey completed by GT Consulting in November of 1997 found no redds in a reach of Big Creek with public access (GT Consulting 1999).

5.1.5 Temperature

An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described Big Creek as “functioning at risk” due to temperature (Hendrickson and Cikanek 2000). This assessment was based mostly on aerial photo review and qualitative data.

The Lolo National Forest in cooperation with DEQ deployed one thermograph on Big Creek in 2001 from the middle of July to the middle of October. The site was located about half a mile upstream from the mouth. The 2001 temperature data documented a maximum temperature of 66.3°F on August 7, and the highest weekly maximum temperature (7DADMT) was 65.4°F, both well above the indicator threshold of 54°F.

In 2006, DEQ deployed ten thermographs in the Big Creek watershed, including two in the mainstem of Big Creek. The thermographs were deployed on July 11, 2006, and retrieved on September 11 and 12, 2006. At the upper Big Creek site, located just below the confluence of the east and west forks of Big Creek, the highest temperature was 59.5°F and the 7-day highest weekly maximum temperature (7DADMT) was 59.0°F. Both exceeded the indicator of 54°F. At the lower Big Creek site located near the mouth of the stream in the vicinity of the railroad bridge, the maximum temperature was 65.8°F, and the 7-day highest weekly maximum temperature (7DADMT) was 65.0°F. Both exceeded the indicator of 54°F. Throughout the remainder of the monitoring network in the Big Creek Watershed (including the east, west, and middle forks) maximum temperatures ranged from a low of 58.2°F at the mouth of the west fork to a high of 66.8°F in the west fork above the middle fork. Temperatures in Big Creek exceed critical thresholds for bull trout. Results from all sites in the 2006 Big Creek Watershed temperature monitoring network are summarized in **Tables 5-2a and b** and in **Appendix C.**

Temperature, stream discharge, effective shade, and canopy cover data were used to run the QUAL2K model to evaluate temperatures in Big Creek relative to Montana's water quality standards. The maximum temperatures predicted in the model scenario for increased shading and decreased thermal inputs from tributaries were compared to the maximum temperatures predicted by the model for the existing shade conditions. The QUAL2K model results indicated that stream temperature along the mainstem of Big Creek could be decreased by greater than 1ºF by increasing the amount of shade (**Appendix C**). A slight additional reduction in stream temperature could be achieved by decreasing temperatures on tributary streams. Warm water inputs from the East Fork and West Fork were also identified as sources of increased stream temperatures to Big Creek. Much of the human thermal impacts from the three forks of Big Creek are reset by a large beaver complex that appears to promote groundwater infiltration which emerges in Big Creek downstream as cooled water. Because of the beaver complex and groundwater interaction, activities in the headwaters do not translate to significant heating in the lower watershed. Even so, the heating due to human activities from the beaver complex to the mouth appears to cause a violation of Montana's temperature standards. Localized riparian and stream channel impacts do influence temperature along Big Creek below the confluence of the three forks.

Table 5-2a. 2006 Temperature Data Summary for Big Creek Watershed

Site Name	Seasonal Maximum		Seasonal Maximum 7-Day Averages	
	Date	Value	Date	Daily Maximum
West fork Big Creek upper site	07/24/06	66.4	07/25/06	65.7
West fork above Middle fork "notch"	07/23/06	66.8	07/25/06	66.0
West fork at mouth, above east fork	07/24/06	58.2	07/23/06	57.7
Middle Fork-upper site at upstream end of meadow	07/24/06	63.1	07/25/06	62.1
Middle fork above West fork	07/24/06	65.2	07/24/06	64.5
EF Big Creek	07/23/06	61.7	07/25/06	60.7
East Fork above mouth	07/24/06	60.8	07/25/06	60.2
EF Big Creek, lower most fork	07/24/06	62.3	07/25/06	61.5

Table 5-2a. 2006 Temperature Data Summary for Big Creek Watershed

Site Name	Seasonal Maximum		Seasonal Maximum 7-Day Averages	
	Date	Value	Date	Daily Maximum
Big Creek below E and W forks	07/24/06	59.5	07/25/06	59.0
Big Creek by railroad bridge	07/24/06	65.8	07/25/06	65.0

Table 5-2b. Continued 2006 Temperature Data Summary for Big Creek Watershed

Site Name	Days > 50 F	Days > 59 F	Days > 70 F
530220- West fork Big Creek upper site	64	34	0
530250-West fork above Middle fork "notch"	64	54	0
584786-West fork at mouth, above east fork	62	0	0
530247-Middle Fork-upper site at upstream end of meadow	63	14	0
584807-Middle fork above West fork	63	21	0
530225-EF Big Creek	64	9	0
530206-East Fork above mouth	63	7	0
530219-EF Big Creek, lower most fork	63	11	0
530232-Big Creek below E and W forks	63	2	0
530209-Big Creek by railroad bridge	63	46	0

5.1.6 Big Creek Water Quality Status Summary

Big Creek is listed as impaired due to sediment and temperature on the 2006 303(d) List. Available sediment and habitat data suggest that fine sediment deposition within Big Creek is impairing the cold water fishery and aquatic life beneficial uses. Temperature data from both 2001 and 2006, as well as temperature modeling results, also support the conclusion that Big Creek is impaired due to elevated temperatures. As a result, TMDLs will be developed for sediment and temperature in the Big Creek Watershed.

5.2 Deer Creek

The 1996 303(d) List reported Deer Creek from its headwaters to its mouth was threatened for coldwater fisheries uses. The probable cause of impairment was thermal modifications. Probable sources of impairment included agriculture and irrigated crop production. In 2006, Deer Creek was determined to be fully supporting all of its designated beneficial uses.

5.2.1 Sediment

An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described Deer Creek as “functioning at unacceptable risk” due to sediment based on a qualitative assessment of watershed conditions, primarily related to roads. The Deer Creek watershed was identified as having a road density of 2.2 miles/mile^2, with 35% of the stream having roads within 300 feet of the banks a third of which are within 125 feet of the stream (Hendrickson and Cikanek 2000).

In August of 2001, DEQ performed physical, chemical, and biological water quality assessments at two sites on Deer Creek. The upper sample site was about three miles below the headwaters, while the lower site was near the mouth. The assessments included field measurements, photo documentation, a riparian survey, sampling for aquatic insects and algae, and water column measurements. A third site was sampled for water column measurements below an old placer operation and above the confluence with Cromie Creek.

Based on the 2001 assessment, DEQ reported the headwaters site was an entrenched Rosgen A3 stream type, while the lower site was a Rosgen D3 stream type, The potential of the lower site was a Rosgen C stream type according to the assessment team, suggesting an overwidened condition, and thus the width/depth ratio supplemental indicator value of ≤33 for Rosgen C-type streams was likely not being met. This appeared to be a localized impact most likely due to the lower portion of Deer Creek responding to St. Regis River degradation (downcutting) from transportation effects. The percent of surface sediment <2mm was meeting the preliminary target value of <20% at both sites, with a value of 0% at the upper site and 6.7% at the lower site. The headwaters site was rated as "sustainable" from the perspective of riparian integrity and scored 100% of the potential criteria. Notations were made about abundant woody debris. The lower site was rated as "at risk" from the perspective of riparian integrity. Notations were made about channel braiding, which was thought to be caused by a local base level change on the St. Regis River and an unstable riparian area.

During 2002 the USFS collected R1/R4 fisheries habitat data along two reaches of Deer Creek. Eroding bank frequency and the amount of undercut bank are comparable to undeveloped watersheds. Large woody debris count results vary greatly by reach. McNeil core data collected in 2003 during a separate effort at a site approximately 1 mile upstream of the mouth indicated that the fine sediment <6.3 mm comprised 27.4% of the sample, meeting the target of <28%. The associated percent surface fines using a grid toss in the same pool tail location as the McNeil core was 22.4% fines <6.3 mm.

5.2.2 Macroinvertebrates

Macroinvertebrate data were collected at two sites in Deer Creek in 2001. At site C04DEERC01, the Mountain MMI was 81.9, meeting the supplemental indicator value of >63 for impairments. The RIVPACS O/E score of 1.18 also met the supplemental indicator value of 1.2>RIVPACS>0.8. At site C04DEERC03 where very localized stream channel degradation may be occurring due to impacts on the St. Regis River, the Mountain MMI was 57.5, falling below the supplemental indicator value of >63. The RIVPACS O/E score was 1.0, meeting the supplemental indicator value of 1.2>RIVPACS>0.8.

5.2.3 Periphyton

The 2001 DEQ periphyton bioassessment showed good biological integrity at both sites (Bahls 2002).

5.2.4 Fish Populations

The Montana Interagency Stream Fishery database rated Deer Creek as “moderate” relative to its suitability for bull trout and Westslope cutthroat trout habitat. The trend for aquatic habitat quality was rated as “static” and aesthetics were rated as “above average” (MFWP 1985). Recent fishery investigation indicates that brook trout and cutthroat trout are the predominant game fish species present (pers. com. Knotek). The overall habitat and resource value assigned to Deer Creek was “outstanding” (MFISH 2004).

An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described bull trout and westslope cutthroat trout populations as “depressed” in Deer Creek (Hendrickson and Cikanek 2000).

5.2.5 Temperature

The Lolo National Forest in cooperation with DEQ deployed one thermograph on Deer Creek in 2001 from the middle of July to the middle of October near the mouth **(Appendix D)**. The 2001 temperature data documented a maximum temperature of 57.9°F on August 7, and the 7-day highest weekly maximum temperature (7DADMT) was 57.3°F, which is above the indicator of 54°F for bull trout rearing, but below the 59°F indicator for adult thermal habitat. Temperature data were collected again in 2002 and 2003, with 7DADMTs reaching 55.9°F and 57.4°F respectively. Although the 54°F indicator for bull trout rearing was not always met near the mouth, an aerial photo (2005 NAIP) and field reconnaissance thermal source assessment effort indicated limited thermal sources in the watershed that can be restored using reasonable land, soil, and water conservation practices. The aerial photo assessment that was conducted as part of the of the Endangered Species Act bull trout consultation identified Deer Creek as having one of the most dense riparian canopies in the St. Regis Watershed. Although there are some limited historic impacts to riparian shade on several of Deer Creek’s smaller tributaries, the mainstem canopy is generally healthy where thermal impacts would be the greatest from riparian disturbance. Inferences from temperature modeling results that assessed tributary impacts to Twelvemile Creek suggest that this level of harvest on Deer Creek’s tributaries is not likely to increase temperatures above Montana’s temperature standard because the main stem has a very robust riparian canopy. Also, most of the tributary harvest occurred at least a decade ago and riparian shade on the small tributaries recovers more quickly than on larger streams because of the relation of stream width and canopy height (i.e. shrubs or small trees can provide more shade on a small stream than a large stream). Additionally, a few lakes in the headwaters of tributaries may contribute to what appears to naturally occurring temperatures in excess of the <54°F indicator.

An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described Deer Creek as “functioning at risk” due to temperature but this assessment was based on a coarse scale assessment of watershed conditions. (Hendrickson and Cikanek 2000).

5.2.6 Deer Creek Water Quality Status Summary

Deer Creek was listed on the 1996 303(d) List as impaired due to temperature. The 54°F indicator for bull trout rearing was not always met at the monitoring location near the confluence with the St. Regis River, so conditions that influence stream temperature were investigated. An aerial photo and field reconnaissance thermal source assessment effort indicated robust shade conditions along the stream. By using inference from the reconnaissance and temperature modeling results that assessed tributary impacts to Twelvemile Creek, it was concluded that the level of harvest on Deer Creek's tributaries is not likely to increase temperatures above Montana's temperature standard because the main stem of Deer Creek has a very robust riparian canopy. Although there are limited historic areas with riparian shade impacts, mostly on small tributaries, the mainstem canopy is healthy where thermal impacts would be the greatest from riparian disturbance. Deer Creek is near its naturally occurring temperature condition. Therefore, a temperature TMDL will not be completed for Deer Creek. Riparian tree harvest BMPs identified in **Section 8** should be followed throughout this watershed to ensure that temperature conditions do not degrade in the future.

5.3 Little Joe Creek

The 1996 303(d) List reported Little Joe Creek from the North Fork to the mouth was threatened for coldwater fisheries uses. Probable causes of impairment included siltation and other habitat alterations. Probable sources of impairment included highway/road/bridge construction and silviculture. In 2006, Little Joe Creek was listed as partially supporting aquatic life and coldwater fisheries. Probable causes of impairment include sedimentation/siltation, physical substrate habitat alterations, and alteration in stream-side or littoral vegetative covers. Probable sources of impairment include construction and highway/road/bridge construction, natural sources, and streambank modifications/destabilization.

5.3.1 Sediment

An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described Little Joe Creek as "functioning at unacceptable risk" due to sediment. The Little Joe Creek watershed was identified as having a road density of 2.5 miles/mile^2, with 37% of the stream having roads within 300 feet of the banks about half of which are within 125 feet of the stream (Hendrickson and Cikanek 2000).

In August of 1989, DEQ performed a non-point source assessment along the entire length of Little Joe Creek, and then in July of 2001 the agency performed physical and biological water quality assessments at two sites on Little Joe Creek. The lower sample site in 2001 was approximately one third of a mile above the mouth, while the upper site was less than a half mile below confluence with the North and South Forks of Little Joe Creek. The assessments included field measurements, photo documentation, and a riparian survey. No water was present at the upper sample site, so sampling for aquatic insects, algae, and water column measurements occurred only at the lower site. The dewatered condition was created by water loss to subsurface flow.

DEQ reported the lower site was a Rosgen C3 stream type with a width/depth ratio of 15-20 and an entrenchment ratio of 2 based on an assessment in 2001. This width/depth ratio was meeting supplemental indicator criteria of ≤33 for Rosgen C-type streams. The percent of sediment <2mm was meeting the target value of <20% at both sites, with a value of 2.7% at the upper site and 0.9% at the lower site. Side channels were noted during this assessment. The upper site was rated as "sustainable" from the perspective of riparian integrity. Notations were made about channel incisement, deposition of large cobbles and gravels, and undesirable road impacts on the stream. The lower site was rated as "at risk" from the perspective of riparian integrity. Notations were made about the occurrence of channel downcutting and active lateral bank erosion. Riparian disturbance was indicated by the presence of noxious weeds.

During the 1989 assessment by DEQ, potential sediment sources identified were a mass wasting area and roads. An extensive road network was noted in the watershed, though roads were usually of "adequate" distance from stream. It was noted that riparian disturbance was generally limited to areas where a road was close to the stream. Stable banks, gravel bar development, and areas of scour were noted. Some water loss to subsurface flow was suggested.

In 2002 and 2003, physical measurements were performed on Little Joe Creek to quantify existing conditions relative to sediment related impairments. A brief review of the results is presented below. Additional information can be found in **Appendix B.**

Sediment impairments in Little Joe Creek were expressed as high riffle stability index values, a high amount of fine sediment <2mm in riffles and high bankfull width/depth ratios. A riffle stability index value of 92 exceeded the water quality target of <75, suggesting excess sediment loads (**Table 5-3**). With a value of 28.1, the percent of fine sediment <2mm in riffles exceeded the target of <20%. Grid toss percent surface fines <6mm measurement were made at two locations. At 4.1% and 1.4%, both met the target value of <8.0. The mainstem of Little Joe Creek contained a Rosgen C4 channel with a maximum width/depth of 34.2, which exceeded the supplemental indicator value of ≤33. Bankfull channel widths ranged from 36.8 to 81.5 feet, indicating that a numeric pool frequency does not apply likely due to overridden conditions, though pool frequency values of 37, 38, and 77 pools per mile were reported. Two measurements of large woody debris per mile found a range of conditions, with 1,204 pieces per mile in one assessment and 48 pieces per mile from a second assessment. The lower value falls below the supplemental indicator value of at least 104 pieces per mile for streams greater than 35 feet wide. The channel sinuosity was 1.14, which was below the supplemental indicator criteria of >1.2.

Table 5-3. Little Joe Creek physical assessment data

Survey Reach	Bankfull Width	Width/ Depth Ratio	Stream Type	Grid-toss % PSF Lateral Scour Pools (mean)	Pebble Count % Surface Fines <2mm in Riffles	Sinuosity	RSI	Pools/ Mile	LWD/ Mile
LNF Hydro 1	36.8	26.5	C4	4.1	4	1.14	92	77	
LWC XS1	66.4	34.2	C4						
LWC XS2	81.5	32.6	C4		28.1			38	1204
LWC XS3	44.8	18.7	C4						
LNF Fish 2			C4	1.4				37	48

It should be noted that no McNeil core samples were collected in Little Joe Creek due to a lack of appropriate spawning gravels. However, McNeil core samples collected on both the South Fork and North Fork of Little Joe Creek provide indicators of upstream sediment loads. McNeil core samples were meeting water quality targets in both tributary streams, with percent fines <6.3mm of 21.7 in the South Fork and 28.0 in the North Fork. However, the sample site on the South Fork Little Joe was relatively high in the watershed and may not accurately represent anthropogenic disturbance between the sample site and the confluence with the North Fork.

5.3.2 Macroinvertebrates

Macroinvertebrate data were collected at one site in Little Joe Creek in 2001. At site C04LJOEC02, the Mountain MMI was 54.0, failing to meet the supplemental indicator value of >63 for impairment, while the RIVPACS O/E score of 0.95 did meet the supplemental indicator value of 1.2>RIVPACS>0.8.

5.3.3 Periphyton

The 2001 DEQ periphyton bioassessment showed good biological integrity at the lower site. A very low siltation index value was reported (Bahls 2002).

5.3.4 Fish Populations

Little Joe Creek is considered important spawning habitat for Westslope cutthroat trout and bull trout. However, a bull trout redd survey in October of 1995 conducted by the U.S. Forest Service did not find any bull trout redds. A separate, limited survey conducted in November of 1997 by GT Consulting found no redds in the first 1000 feet upstream of the mouth (GT Consulting 1999). The Montana Interagency Stream Fishery database recorded trout species presence, but did not rate Little Joe Creek relative to its suitability for trout residence, spawning or rearing. Reported issues included excess siltation, road construction, and logging practices. The trend for aquatic habitat quality was rated as "deteriorating," yet aesthetics were rated as "above average" (MFWP 1985). Recent fishery investigation indicates that bull trout, brook trout, and cutthroat trout are the predominant game fish species present (pers. com. Knotek). Bull trout redds have been observed from 2002-2005 in both the South Fork and North Fork Little Joe Creeks (pers. com. Knotek). An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described the Westslope cutthroat trout population of Little Joe Creek as “strong,” while the bull trout population was considered “depressed” (Hendrickson and Cikanek 2000).

5.3.5 Temperature

An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described Little Joe Creek as “functioning at risk” due to temperature (Hendrickson and Cikanek 2000).

The Lolo National Forest in cooperation with DEQ deployed one thermograph on Little Joe Creek in 2001 from the middle of July to the middle of October near the mouth. The 2001 temperature data documented a maximum temperature of 53.8°F on August 7. The temperature never exceeded 54°F, which is the upper limit for bull trout rearing suggested by USFWS. The highest weekly maximum temperature (7DADMT) was 53.4°F, meeting the indicator of 54°F. Temperatures in Little Joe Creek were monitored again in 2002 and 2003, with 7DADMTs of 50.9 and 52.0, respectively meeting the indicator of 54°F. Little Joe Creek is likely this cold because the entire stream flows subsurface upstream of this site and emerges as cooled groundwater.

5.3.6 Little Joe Creek Water Quality Status Summary

Little Joe Creek is listed as impaired due to sedimentation/siltation and habitat related listings on the 1996 and 2006 303(d) List. Assessments conducted in 2002 and 2003 revealed several exceedences of water quality targets and supplemental indicators. These exceedences relate to fine sediment deposition and lack of channel function that likely impact sediment transport. Low amounts of pool habitat likely impact the fishery. Fine sediment appears to impact the fishery and macroinvertebrate populations, and forest roads are a significant source of sediment in the Little Joe Creek watershed. As a result, a TMDL will be developed for sediment in the Little Joe Creek Watershed.

5.4 North Fork Little Joe Creek

The 1996 303(d) List reported North Fork Little Joe Creek from the headwaters to the mouth was threatened for coldwater fisheries uses. Probable causes of impairment included siltation and other habitat alterations. The probable source of impairment was highway/road/bridge construction. In 2006, North Fork Little Joe Creek was listed as partially supporting aquatic life and coldwater fisheries. The probable cause of impairment was sedimentation/siltation. The probable source of impairment was highway, road, bridges, and infrastructure.

5.4.1 Sediment

In July of 2001, DEQ performed physical, chemical, and biological water quality assessments at two sites on North Fork Little Joe Creek. The lower sample site was approximately a half mile above the confluence with the mainstem of Little Joe Creek, while the upper site was approximately seven miles upstream of the lower site. The assessments included field measurements, photo documentation, a riparian survey, sampling for aquatic insects and algae, and water column measurements.

Based on an assessment in 2001, DEQ reported the upper site was a Rosgen B3 stream type with a width/depth ratio of 10. The lower site was also a Rosgen B3 stream type with a width/depth ratio of 20. Both sites were meeting the width/depth ratio supplemental indicator criteria of ≤22 for Rosgen B-type streams. The percent of sediment <2mm was meeting the target value of <20% at both sites, with a value of 13.7% at the upper site and 0.8% at the lower site. A third pebble count conducted at site "1.5" had a value of 4.4% <2mm, which was also meeting the target criteria. The 13.7% value was the highest amount of fine sediment <2mm found within the St. Regis TPA during DEQ monitoring in 2001. The upper site was rated as "sustainable" from the perspective of riparian integrity and scored 100% of the potential criteria. Notations were made about abundant woody debris, healthy riparian vegetation and beneficial shading. The lower site was rated as "at risk" from the perspective of riparian integrity. Notations were made about upstream entrenchment causing deposition at the site, unstable streambanks, and inadequate material available for energy dissipation. Field notes indicated that shading was adequate, but bare ground was present in the riparian area and that stream flows diminished due to discharge to ground water.

A 1997 Lolo National Forest report indicated that an unidentified reach on North Fork Little Joe Creek had a higher fraction of surface fines with a greater representation of particles 100 mm or greater when compared to streams of similar Rosgen stream type and geology. High road densities in the watershed and numerous stream crossings were theorized to be responsible for this difference (Rosquist and Sytle 1997).

In 2002 and 2003, physical measurements were performed on North Fork Little Joe Creek by USFS and LWC to quantify existing conditions relative to sediment related impairments. A brief review of the results is presented below. Additional information can be found in **Appendix B.**

A riffle stability index value of 78 exceeded the water quality target of <75 at one site; at a second site the RSI was 75, right at the target; and at 55 at a third location was below the target **(Table 5-4)**. A riffle stability value of zero at the forth site indicates a lack of bars and potential channelization, though it is unclear if this is the result of natural or anthropogenic sources. The McNeil core value of 27.6% fines than 6.3 mm is meeting target conditions of ≤28% but the sampling location is above many of the road impacts in the watershed and near the target criteria. Also, this section of the stream has natural energy to transport sediment. A grid-toss PSF value of 7.5 accompanying the McNeil core sample was meeting target criteria of ≤8 but also near the criteria. Pebble counts conducted in riffles ranged from 14% to 19% fines <2mm, nearing the target limit. North Fork Little Joe Creek ranged from a Rosgen C3/4b to a C4 stream type, with width/depth ratios ranging from 10.4 to 19.6; thus remaining below supplemental indicator criteria for both Rosgen B and C stream types. Pool frequency values ranged from 0 to 335 pools per mile, indicating some reaches were not meeting water quality targets. Width to depth ratios met supplemental indicator conditions at all monitoring locations. Large woody debris ranged from 84 to 264 pieces per mile which indicates that conditions approximate the minimum supplemental indicator value.

Table 5-4. North Fork Little Joe Creek physical assessment data

Survey Reach	Bankfull Width (feet)	Width/ Depth Ratio	Stream Type	Grid-toss % PSF Lateral Scour Pools (mean)	Pebble Count % Surface Fines <2mm in Riffles	McNeil Core % Surface Fines <6.3mm	RSI	Pools/ Mile	LWD/ Mile
LNF Hydro 1	18.6	19.6	C4	75.5	18		78	0	
LNF Hydro 1a	21.7	10.4	C4b	14.3	19		55	335	
LNF Hydro 2	18.1	12.8	C3b	4.1	15		0	0	
LNF Hydro 4	20.2	16.9	C4b	0.0	14		75	300	
LNF Fish 1			C4	1.3				55	84
LNF Fish 4			C4	1.6				146	264
0.5 miles above conf. with South Fork				7.5		28.0			

5.4.2 Macroinvertebrates

Macroinvertebrate data were collected at two sites in the North Fork of Little Joe Creek in 2001. At site C04NFLJC01, the Mountain MMI was 80.7, meeting the supplemental indicator value of >63 for impairments. The RIVPACS O/E score of 1.14 also met the supplemental indicator value of 1.2>RIVPACS>0.8. At site C04NFLJC02, the Mountain MMI was 73.7, meeting the supplemental indicator value of >63, and the RIVPACS O/E score was 1.12, meeting the supplemental indicator value of 1.2>RIVPACS>0.8.

5.4.3 Periphyton

The 2001 DEQ periphyton bioassessments showed good biological integrity at the lower site. At the upper site, low diatom diversity and species richness were reported, though natural conditions (scour) were thought to be responsible (Bahls 2002).

5.4.4 Fish Populations

The Montana Interagency Stream Fishery database rated reaches of North Fork Little Joe Creek as “average” or “below average” relative to its suitability for trout residence, spawning and rearing. Problems were caused by a lack of spawning areas, inadequate pool frequencies, a lack of undercut banks, bedload transport, siltation and road constriction. Problem sources included roads and logging practices. The trend for aquatic habitat quality was rated as “static” or “deteriorating” and aesthetics ratings ranged from “above average” to “below average” (MFWP 1985 Recent fishery investigation indicates that bull trout, brook trout, and cutthroat trout are the predominant game fish species present (pers. com. Knotek). Bull trout redds have been observed from 2002-2005 in both the South Fork and North Fork Little Joe Creeks (pers. com. Knotek).

The overall habitat and resource value assigned to North Fork Little Joe Creek is “outstanding” (MFISH 2004).

5.4.5 Temperature

The Lolo National Forest in cooperation with DEQ deployed one thermograph on North Fork Little Joe Creek in 2001 from the middle of July to the middle of October near the mouth **(Appendix D)**. The 2001 temperature data documented a maximum temperature of 56.6°F on August 13, and the highest weekly maximum temperature (7DADMT) was 56.0°F, which is slightly above temperature supplemental indicator of <54°F. Although the 54°F indicator was not always met at this monitoring site near the mouth, an aerial photo and field reconnaissance thermal source assessment effort indicates limited thermal sources in the watershed that can be restored using reasonable land, soil, and water conservation practices.

5.4.6 North Fork Little Joe Creek Water Quality Status Summary

North Fork Little Joe Creek is listed as impaired due to sedimentation/siltation on the 2006 303(d) List. Assessments conducted by DEQ in 2001 and USFS during 2002/03 indicated that the stream is generally nearing its target and supplemental indicator values upstream of some road impacts. It is likely the road network is increasing sediment below the sites that had borderline sediment conditions and likely causes impacts to fish spawning. McNeil core and percent fine grid tosses should be assessed below areas with heavier road impacts to better understand impairment status. Most other targets and supplemental indicators, as well as macroinvertebrate and periphyton communities, are meeting set goals. Because there is uncertainty in the impairment condition of the fishery and fine sediment conditions are borderline in spawning areas above some of the more significant road impact areas, a sediment TMDL will be developed for the watershed.

5.5 Silver Creek

The 1996 303(d) List reported Silver Creek from its headwaters to its mouth was threatened for coldwater fisheries uses. The probable cause of impairment was thermal modifications. Probable sources of impairment included agriculture and irrigated crop production. In 2006, Silver Creek was listed as partially supporting coldwater fisheries uses. The probable cause of impairment was flow alterations and is due to a culvert acting fish passage barrier, which is not a pollutant.

5.5.1 Sediment

This information is provided to assist in sediment source assessment for the St. Regis River. An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described Little Joe Creek as “functioning at unacceptable risk” due to sediment but this assessment was based on a qualitative assessment of watershed conditions. (Hendrickson and Cikanek 2000).

In July of 2001, DEQ performed physical, chemical, and biological water quality assessments at two sites on Silver Creek. The upper sample site was just below the outlet of Silver Lake, while the lower site was approximately a half mile above the mouth. The assessments included field measurements, photo documentation, a riparian survey, sampling for aquatic insects and algae, and water column measurements

DEQ reported Silver Creek was a Rosgen C3 stream type at the upper site, which is just downstream of Silver Lake, but quickly becomes a steep Rosgen A2 stream type with an approximate width/depth ratio of 2.5, which was meeting the supplemental indicator criteria of ≤12 for Rosgen A-type streams. The lower site was a Rosgen B2 stream type with a width/depth ratio of 5-10 and an entrenchment ratio of 2-3, which was meeting the supplemental indicator criteria of ≤23 for Rosgen B-type streams. The percent of sediment <2mm was meeting the target value of <20% at both sites, with a value of 10.7% at the upper site and 1.9% at the lower site. The upper site was rated as “sustainable” from the perspective of riparian integrity and scored 100% of the potential criteria. The lower site was also rated as “sustainable” from the perspective of riparian integrity, and scored 96% of the potential criteria. Notations were made about abundant woody debris, healthy riparian vegetation, and beneficial shading.

5.5.2 Macroinvertebrates

Macroinvertebrate data were collected at two sites in Silver Creek in 2001. At site C04SLVRC01, the Mountain MMI was 46.4, failing to meet the supplemental indicator value of >63 for impairments The RIVPACS O/E score of 0.61 also failed to meet the supplemental indicator value of 1.2>RIVPACS>0.8. It is likely that the lake influence from just upstream affects the aquatic insect community. At site C04SLVRC02, the Mountain MMI was 60.6, failing to meet the supplemental indicator value of >63, while the RIVPACS O/E score was 0.94, meeting the supplemental indicator value of 1.2>RIVPACS>0.8.

5.5.3 Periphyton

The 2001 DEQ periphyton bioassessments showed good biological integrity at the upper site, while natural disturbance was thought to influence biological integrity at the lower site (Bahls 2002).

5.5.4 Fish Populations

The Montana Interagency Stream Fishery database recorded trout species presence, but did not rate Silver Creek relative to its suitability for trout residence, spawning, or rearing. The trend for aquatic habitat quality was rated as “static” and aesthetics were rated as “average” (MFWP 1985). Recent fishery investigation indicates that brook trout and cutthroat trout are the predominant game fish species present (pers. com. Knotek). The overall habitat and resource value assigned to Silver Creek is “outstanding” (MFISH 2004).

An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described bull trout and

Westslope cutthroat trout populations as “depressed” in Silver Creek (Hendrickson and Cikanek 2000).

A culvert near the mouth of Silver Creek acts as a fish barrier. Silver Creek makes a 90-degree turn to flow into the culvert which has a vertical junction that then immediately drops Silver Creek several feet. Because of the vertical drop and high velocities through the undersized structure, the culvert is a definite fish barrier.

5.5.5 Temperature

The Lolo National Forest in cooperation with DEQ deployed two thermographs on Silver Creek in 2001 from the middle of July to the middle of October near the mouth. One site corresponded with the upper Silver Creek assessment site described above, while the other site was located at the forest boundary near the mouth. At the upper site, the 2001 temperature data documented a maximum temperature of 72.6°F on August 14, and the 7-day highest weekly maximum temperature (7DADMT) was 71.3°F, which exceeds the supplemental indicator of 54°F However, the elevated stream temperature at this site appear to be a natural condition due to heating of the water in Silver Lake. At the lower site, the 2001 temperature data documented a maximum temperature of 63.1°F on August 14, and the 7DADMT was 62.1°F, which exceeded the supplemental indicator of 54°F. However, as is the case at the upper site, elevated temperatures appear to result to a large extent from heating of Silver Lake, which is the source of Silver Creek. The thermographs were deployed again at both locations in 2002, with 7DADMTs reaching 64.5°F at the upper site near the lake outlet and 58.6°F at the lower site near the mouth. Aerial photo review indicates few, if any, human caused sources of heating in the watershed. Roads were generally built away from the stream network, and there were not signs of tree harvest in riparian areas in aerial photos.

An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described Silver Creek as “functioning at risk” due to temperature, but this assessment was based on a coarse scale assessment of watershed conditions. (Hendrickson and Cikanek 2000).

5.5.6 Silver Creek Water Quality Status Summary

Silver Creek appears on the 2006 303(d) List as impaired due to other flow regime alterations, but was listed as threatened for thermal modifications on the 1996 303(d) List. The culvert at the mouth of Silver Creek is the primary reason for the 2006 listing. Monitoring in 2001 and 2002 indicated elevated temperatures in Silver Creek, though it was determined that this was a natural condition due to heating of the water in Silver Lake. A reconnaissance and aerial photo effort indicated that there has been little human impact to riparian shade in the watershed. Stream flows, and thus thermal buffering capacity, are also not affected by human activity. Since elevated stream temperatures are the result of natural processes, it was concluded that Silver Creek is not impaired due to thermal modifications. No TMDL is needed for Silver Creek. The culvert should be assessed for removal or upgrade. Riparian tree harvest BMPs identified in Section 8 should be followed throughout this watershed to ensure that temperature conditions do not degrade in the future. Future urban and recreational development should not decrease stream shade.

5.6 Twelvemile Creek

The 1996 303(d) List reported Twelvemile Creek from its headwaters to its mouth was threatened for coldwater fisheries uses. Probable causes of impairment included siltation and other habitat alterations. Probable sources of impairment included highway/road/bridge construction and silviculture. On the 2006 303(d) List, Twelvemile Creek was listed as partially supporting aquatic life and coldwater fisheries uses. Probable causes of impairment include sedimentation/siltation, physical substrate habitat alterations, and water temperature.

5.6.1 Sediment

In August of 2001, DEQ performed physical, chemical, and biological water quality assessments at one site on Twelvemile Creek about a half mile above the East Fork and near the Cabin City Campground. The assessments included field measurements, photo documentation, a riparian survey, sampling for aquatic insects and algae, and water column measurements.

In 2001, DEQ reported Twelvemile Creek was a Rosgen B3 stream type with a width/depth ratio of 17 and an entrenchment ratio of 2. This site was meeting the width/depth ratio supplemental indicator value of ≤23 for Rosgen B-type streams. The percent of sediment <2mm was meeting the target value of <20% at the site, with a value of 3.3%. The site was rated as "at risk" from the perspective of riparian integrity. Notations were made about former channel downcutting which had begun to stabilize, disturbance to riparian vegetation including the presence of noxious weeds and a shortage of deep rooted species, and inadequate material available for energy dissipation (i.e. woody debris). Field notes indicated that fast moving water limited fish habitat.

A short report on Twelvemile Creek was generated by DEQ staff based on field observations near the mouth of Rock Creek in the fall 2002. The report described the deposition of "unnatural" rock piles in a straightened stretch of Twelvemile Creek. This was thought to be linked to increased channel scour. Lack of access to the creek's floodplain was also documented by cutbank erosion.

A draft TMDL report for the Twelvemile Creek watershed was produced by Land & Water Consulting in November of 2002. Preliminary conclusions identified roads as substantial contributors of in-stream sediment. Eighty-two out of 182 road crossings surveyed were identified as contributing sediment to the stream (Land and Water 2002). Rather than working to finalize the Twelvemile Creek TMDL, DEQ decided to address it within the St. Regis River TMDL.

An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described Twelvemile Creek as "functioning at risk" due to sediment. The Twelvemile Creek watershed was identified as a road density of 3.4 miles/mile^2, with 34% of the stream having roads within 300 feet of the banks, almost half of which are within 125 feet of the stream (Hendrickson and Cikanek 2000).

In 2002 and 2003, physical measurements were performed by USFS and LWC on Twelve Mile Creek to quantify existing conditions relative to sediment related impairments. A brief review of the results is presented below. Additional information can be found in **Appendix B.**

The water quality target of ≤28% sediment <6.3 mm was exceeded with a McNeil core value of 32.8%. A riffle stability index value of 88 at one of the assessment sites exceeded the water quality target of <75, suggesting excess sediment loads (**Table 5-5**). Grid-toss PSF accompanying McNeil cores averaged 7.8%, and was even lower elsewhere in the stream, meeting the target value of ≤8% in all cases. The percent of fine sediment <2 mm in riffles was above the target value of <20% at 2 of 3 locations where it was measured and, at 0%, was below the target at the third. The mainstem of Twelvemile Creek contained Rosgen B3, C3, and C4 stream types at various cross-sections, with bankfull widths ranging from 7.9 to 42.7 across the 5 sites where it was measured. Width/depth supplemental indicator values were exceeded at only one of these site, where the ratio was 42.7. Pool frequency values of 335 and 440 pools per mile were meeting water quality targets, but at other locations pool frequencies were below the indicator at only 18 and 14 per mile. At a fifth location the pool count was 41 per mile; it is unclear what pool target is applicable for this reach since there were both Rosgen B and C stream types and channel width varied from 27.3 to 59.8 feet. A large woody debris frequency was measured at 3 locations and ranged from 70 to 195 pieces per mile, meeting supplemental indicator criteria in all cases. Sinuosity in the lower 1.5 miles of Twelvemile Creek was 1.12, which was below the supplemental indicator criteria of ≥1.2 and is likely a result of channelization associated with road development.

Table 5-5. Twelvemile Creek physical assessment data

Survey Reach	Bankfull Width	Width / Depth Ratio	Stream Type	Grid-toss % PSF Lateral Scour Pools (mean)	Pebble Count % Surface Fines <2mm in Riffles	McNeil Core % Surface Fines <6.3mm	Sinuosity	RSI	Pools / Mile	LWD / Mile
LNF Hydro 1	21.5	12.3	C4	4	22		1.12	88	335	
LNF Hydro 2	16.4	7.9	C4		23		1.5	57	440	
LWC XS1	32.2	15.3	B3							
LWC XS2	59.8	42.7	C3		0				41	195
LWC XS3	27.3	17.1	C3							
LNF Fish 1			C3	4					18	70.4
LNF Fish 2			C3	7.5					14	131.2
Potential spawing reach near old mil				7.8		32.8				

5.6.2 Macroinvertebrates

Macroinvertebrate data were collected at one site in Twelvemile Creek in 2001. At site C04TLVMC01, the Mountain MMI was 64.6, failing to meet the supplemental indicator value of >63 for impairments. The RIVPACS O/E score of 0.90 met the supplemental indicator value of 1.2>RIVPACS>0.8.

5.6.3 Periphyton

The 2001 DEQ periphyton bioassessment showed good biological integrity, though the siltation index and percent abnormal cells were slightly elevated (Bahls 2002).

5.6.4 Fish Populations

A 1965 Fish, Wildlife and Parks report identified 59 artificial structures placed in Twelvemile Creek from 1931 to 1964 for improvement of fisheries habitat (Opheim et al.1965). The habitat enhancements appeared to positively affect westslope cutthroat trout populations, but effects on bull and brook trout were not discernable.

The Montana Interagency Stream Fishery database rated reaches of Twelvemile Creek as “average” or “below average” relative to its suitability for trout residence, spawning, and rearing. Problems were caused by a lack of spawning areas, inadequate pool frequencies, lack of undercut banks and bank cover, and road construction. Human sources included roads and logging practices. The trend for aquatic habitat quality was rated as “static” or “deteriorating” and aesthetics were rated as “average” (MFWP 1985).

Recent fishery investigation indicates that brook trout and cutthroat trout are the predominant game fish species present (pers. com. Knotek). The entire stream is protected by the Northwest Power Planning Council Protected Areas Program to preserve critical fish and game habitat. Although the last mile of the stream is listed in the report as a reach of chronic dewatering concern, no supporting data were located and dewatering is not currently a problem in the stream. The overall habitat and resource value assigned to Twelvemile Creek is “outstanding” (MFISH 2004).

An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described bull trout and Westslope cutthroat trout populations as “depressed” in Twelvemile Creek (Hendrickson and Cikanek 2000).

5.6.5 Temperature

An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described Twelvemile Creek as “functioning at risk” due to temperature (Hendrickson and Cikanek 2000).

The Lolo National Forest in cooperation with DEQ deployed two thermographs on Twelvemile Creek in 2001 from the middle of July to the middle of October. The upper site corresponded with the DEQ assessment site near the Cabin City Campground, while the lower site was close to the mouth and below the confluence with the East Fork. The 2001 temperature data documented a maximum temperature of 67.2°F at the upper site on August 7, and the 7-day highest weekly maximum temperature (7DADMT) was 66.1°F, exceeding the indicator of 54°F. The 2001 temperature data documented a maximum temperature of 64.2°F at the lower site on August 7, and the 7DADMT was 63.5°F, which also exceeded the indicator of 54°F, although this is a south facing watershed and this temperature may not be naturally achievable. Temperature data was collected again in 2002 and 2003 at several sites, and temperatures exceeded the 7DADMT indicator at all locations in both years.

In 2006, DEQ deployed nine thermographs in the Twelvemile Creek watershed, including six in the mainstem of Twelvemile Creek. The thermographs were deployed on July 12, 2006, and retrieved on September 10, 2006. Maximum temperatures ranged from a low of 55.6 °F at the headwaters location to a high of 68.1°F at the site near Rock Creek in the lower watershed. The 7-day 7DADMT in Twelvemile Creek ranged from 54.5°F to 67.1°F, exceeding the supplemental indicator of 54°F at all locations. Results from all sites in the 2006 Twelvemile Creek Watershed temperature monitoring network are summarized in **Tables 5-6a and b** and in **Appendix C.**

Temperature and canopy cover data were used to run the QUAL2K model to evaluate temperatures in Twelvemile Creek relative to Montana's water quality standards. The maximum temperatures predicted in the model scenario for increased shading and decreased tributary inputs were compared to the maximum temperatures predicted by the model for the existing shade conditions. The QUAL2K model results indicated that stream temperature could be decreased by greater than 1ºF by increasing shade along the mainstem of Twelvemile Creek. Additional stream temperature reductions could be achieved by decreasing temperatures on tributary streams. This result suggests that Twelvemile Creek is exceeding Montana's water quality standard, and that reduced shading resulting from riparian anthropogenic disturbance is partially responsible for the increase in stream temperatures.

Table 5-6a. 2006 Temperature Data Summary for the Twelvemile Creek Watershed

Site Name	Seasonal Maximum		Seasonal Maximum 7-Day Averages	
	Date	Value	Date	Daily Maximum
Twelvemile Cr. above Trapper Cabin @ mile marker 8	07/23/06	55.6	07/25/06	54.5
Twelvemile Cr. above Mineral Mt. Cr.	07/24/06	62.7	07/25/06	61.8
Twelvemile Cr. above Flatrock	07/23/06	65.5	07/25/06	64.2
Twelvemile Creek above east fork	07/23/06	67.8	07/25/06	66.6
Twelvemile Cr. Upstream of Rock Cr.	07/23/06	68.1	07/25/06	67.1
Twelvemile at mouth	07/23/06	67.7	07/25/06	66.7
Flat Rock Cr. Above bridge under moss covered log	07/24/06	61.6	07/25/06	60.8
East fork Twelvemile	07/15/06	45.2	07/25/06	44.9
Rock Creek mouth	07/15/06	55.4	07/25/06	54.9

Table 5-6b. Continued 2006 Temperature Data for the Twelvemile Creek Watershed

Site Name	Days > 50 F	Days > 59 F	Days > 70 F
Twelvemile Cr. above Trapper Cabin @ mile marker 8	45	0	0
Twelvemile Cr. above Mineral Mt. Cr.	61	10	0
Twelvemile Cr. above Flatrock	61	24	0
584847-Twelvemile Creek above east fork	61	42	0
Twelvemile Cr. Upstream of Rock Cr.	61	50	0
Twelvemile at mouth	61	43	0
Flat Rock Cr. Above bridge under moss covered log	61	8	0
East fork Twelvemile	0	0	0
Rock Creek mouth	61	0	0

5.6.6 Twelvemile Creek Water Quality Status Summary

Twelvemile Creek is listed as impaired the 2006 303(d) List due to sedimentation/siltation, other physical substrate habitat alterations, and thermal modifications. Assessments conducted in 2002 and 2003 revealed several exceedences of sediment targets and supplemental indicators. Data from several other evaluations suggest siltation in spawning areas and low pool quality within Twelvemile Creek is impairing the cold water fishery beneficial use. Monitoring data from 2001, 2002, 2003, and 2006 as well as temperature modeling results support the listing for temperature impairments. Significant human caused sediment and temperature sources are present. As a result, TMDLs for temperature and sediment will be developed for the Twelvemile Creek Watershed.

5.7 Ward Creek

The 1996 303(d) List reported Ward Creek from its headwaters to its mouth was threatened for coldwater fisheries uses. Probable causes of impairment included thermal modifications and other habitat alterations. Probable sources of impairment included agriculture, highway/road/bridge construction and irrigated crop production. In 2006, the segment was determined to be fully supporting all of its designated uses and it was removed from the 303(d) List.

5.7.1 Sediment

An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described Ward Creek as “functioning at risk” due to sediment. The Ward Creek watershed was identified as having a road density of 3.6 miles/mile^2, with 32% of the stream having roads within 300 feet of the banks, almost half of which are within 125 feet of the stream (Hendrickson and Cikanek 2000).

In August of 2001, DEQ performed physical, chemical, and biological water quality assessments at two sites on Ward Creek. The upper sample site was a little over a half mile above the confluence with Gold Creek, while the lower site was at the mouth. The assessments included field measurements, photo documentation, a riparian survey, sampling for aquatic insects, and algae, and water column measurements.

In 2001, DEQ found the upper site of Ward Creek was a B3 stream type with a width/depth ratio of 9 and an entrenchment ratio of 2. The lower site was described as an A3 stream type with a width/depth ratio of 23 and entrenchment ratio of 2. The width/depth ratio in the A3 reach exceeded the supplemental indicator criteria of ≤12 for Rosgen A-type streams, while the width/depth ratio in the B3 reach was meeting the supplemental indicator criteria of ≤23 for Rosgen B-type streams. Field notes indicated that the stream appeared to be "naturally straight" at both sites. The percent of sediment <2mm was meeting the target value of <20% at both sites, with a value of 7.3% at the upper site and 0.9% at the lower site. The upper site was rated as "sustainable" from the perspective of riparian integrity and scored 100% of the potential criteria. Notations were made about abundant woody debris and decent fish habitat. The lower site was also rated as "sustainable" from the perspective of riparian integrity, and scored 85% of the potential criteria. Notations were made about the absence of young willows, bank undercutting, and that fish habitat was sparse.

McNeil core samples collected near the mouth in 2003 had an average percent fines less than 6.3mm of 24.1, meeting the target of ≤28%. The Forest Service measured percent fines in pool tail areas using a grid toss method during 2002 R1/R4 fisheries assessments. The results were approximately equivalent or were much lower than the Lolo National Forest undeveloped watershed dataset. Pool abundance was variable, likely due to high amounts of woody debris that affects pool formation. Pool quality was lower than reference but also could be affected by large amounts of woody debris creating small pocket pools that were counted in the assessment.

5.7.2 Macroinvertebrates

Macroinvertebrate data were collected at two sites in Ward Creek in 2001. At site C04WARDC01, the Mountain MMI was 79.5, meeting the supplemental indicator value of >63 for impairments, while the RIVPACS O/E score of 1.29 just failed to meet the supplemental indicator value of 1.2>RIVPACS>0.8. Although RIVPACS values above 1.2 can indicate two different scenarios. The first scenario, which likely applies to upper Ward Creek is that the site is a very high quality reference site. The other scenario, which does not apply to Upper Ward Creek, is an enriched nutrient condition. At site C04WARDC02, the Mountain MMI was 74.6, meeting the supplemental indicator value of >63, and the RIVPACS O/E score was 0.96, meeting the supplemental indicator value of 1.2>RIVPACS>0.8.

5.7.3 Periphyton

The 2001 DEQ periphyton bioassessment showed good biological integrity at both sites, though the siltation index was slightly elevated at the lower site (Bahls 2002).

5.7.4 Fish Populations

The Montana Interagency Stream Fishery database recorded trout species presence, but did not rate Ward Creek relative to its suitability for trout residence, spawning, or rearing. The trend for aquatic habitat quality was rated as "static" and aesthetics were rated as "above average" (MFWP 1985). A 1992 Fish Wildlife and Parks report described the status of bull trout in

Montana and identified Ward Creek as an important bull trout stream, though it was unknown whether the stream supported resident and/or ad fluvial populations (Thomas 1992). Recent fishery investigation indicates that cutthroat trout are the predominant game fish species present (pers. com. Knotek). The overall habitat and resource value assigned to Ward Creek is "outstanding" (MFIS 2004).

An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described bull trout and Westslope cutthroat trout populations as "depressed" in Ward Creek (Hendrickson and Cikanek 2000).

5.7.5 Temperature

An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described Ward Creek as "functioning at risk" due to temperature (Hendrickson and Cikanek 2000).

The Lolo National Forest in cooperation with DEQ deployed one thermograph on Ward Creek in 2001 from the middle of July to the middle of October near the mouth. The 2001 temperature data documented a maximum temperature of 55.1°F on August 7 and the highest weekly maximum temperature (7DADMT) was 54.5°F**,** which approximates the 54 °F indicator. Thermographs were redeployed in 2002 and 2003, and measured 7DADMT values of 55.1 and 56.3 respectively. Although these temperatures are slightly higher than the indicator, 2005 NAIP aerial photo review indicates that stream canopy is healthy along the stream corridor except for limited road encroachment and very limited historic clear cut areas in riparian zones. Tributary riparian areas also have adequate riparian canopy, suggesting that human impacts probably have not altered the natural temperature regime of Ward Creek to a significant extent.

5.7.6 Ward Creek Water Quality Status Summary

Temperature data, along with an aerial photo review and field reconnaissance of heat sources indicates that Ward Creek is not impaired due to temperature conditions. Data collected by DEQ and the Lolo National Forest in 2001 supports the conclusion to remove Ward Creek from the 303(d) List for thermal modifications. No indication of impairment from sediment, metals, or nutrients was observed. Riparian tree harvest BMPs identified in Section 8 should be followed throughout this watershed to ensure that temperature conditions do not degrade in the future.

5.8 St. Regis River

The 1996 303(d) List reported the St. Regis River was partially supporting aquatic life and cold water fisheries uses. Probable causes of impairment included siltation and other habitat alterations. Probable sources of impairment included highway/bridge/road construction and silviculture. In 2006, the St. Regis River was listed as partially supporting aquatic life and cold water fisheries uses. Probable causes of impairment include sedimentation/siltation, water temperature, other flow regime alterations, and alteration in stream-side or littoral vegetative covers. Probable sources of impairment include construction, highway/road/bridge infrastructure and runoff, channelization, loss of riparian habitat, and streambank modification/destabilization.

5.8.1 Sediment

In July and August of 2001, DEQ performed comprehensive chemical, physical, and biological water quality assessments at four sites along the St. Regis River. The assessments included riparian surveys, aquatic insect, algae and water sampling, field measurements, and photo documentation. Site 1 was located in the headwaters near Lookout Pass, Site 2 was located downstream of the town of Saltese, while Sites 3 and 4 were located between Ward Creek and the mouth, with Site 4 being near the mouth.

During the 2001 assessment of the St. Regis River, DEQ found the river alternated between Rosgen B, C, and F stream types. In the headwaters, Site 1 was a Rosgen B3 stream type with a width/depth ratio of 8. Downstream of Site 1, the stream was observed to be an F2/3 stream type with a width/depth ratio of 40 and an entrenchment ratio of 9. Downstream of Saltese, Site 2 was a C3 stream type with a width/depth ratio of 50. Site 3 was a Rosgen C2/3 stream type with a width/depth ratio of 20. Site 4 was a B3 stream type with a width to depth ratio of 70. Based on the high width/depth ratio, it was suggested that this reach may have the potential of being a Rosgen C stream type. A width/depth ratio of 50 at Site 2 exceeded the supplemental indicator value of ≤33 for Rosgen C-type streams, while a width/depth ratio of 70 at Site 4 exceeded the supplemental indicator value of ≤22 for Rosgen B-type streams. At sites 1 and 4, width/depth ratios were within expected ranges. The percent of sediment <2mm was meeting the preliminary supplemental indicator value of <20% at all sites, with a values of 0% at the uppermost and lowermost sites, and values of 5.5 and 2.9 at Sites 3 and 4, respectively. Three out of the four sites assessed by DEQ in 2001 were rated as "sustainable" from the perspective of riparian integrity, while the uppermost site was rated "at risk". Notations were made about the effects of I-90, the old state highway, and the railroad grade on channel integrity, width/depth ratios, pool frequency, the amount of cover and shading, and the densities of large woody debris.

An assessment of bull trout habitat issues prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act described the St. Regis River as riffle-dominated with "very little habitat heterogeneity" due to constriction of the river by Interstate 90 and the railroad. In the St. Regis watershed overall, the analysis of the amount of stream length encroached upon by roads within 300' and 125' shows that 33% of stream lengths in the St. Regis Watershed have roads within 300' and 15% of the streams are encroached by roads within 125'. Nine out of twelve of the HUC 6 tributary watersheds to the St. Regis have greater than 30% of their streams' length encroached upon by roads within 300' (Hendrickson and Cikanek 2000).

In 1990, contractors to Montana Department of Health and Environmental Sciences (MDHES) performed standardized field based non-point source stream reach assessments on each of five reaches of the St. Regis River from its headwaters to the confluence with the Clark Fork River. The assessments provided qualitative appraisals of adjacent land uses, stream channel and bank characteristics, riparian vegetation, water appearance, potential non-point pollution sources, and presence or absence of best management practices. Widespread impacts associated with the railroad and highway transportation corridor were observed throughout the surveyed sections of the river. These included extensive channel straightening, channel encroachment, placement of rock riprap, impacts from bridge and culvert installations, high channel width/depth ratios, loss of riparian vegetation, and a lack of pool habitat (OEA Research 1990).

Previous work conducted by the Montana Fish and Game Commission and the Superior Ranger District of the Lolo National Forest indicated that at least 1.3 miles of total stream length have been lost along the St. Regis River due to the development of the transportation corridor. In 1963 the Montana Fish and Game Commission found 17.9 miles of riprap along the banks of the St. Regis River, and 5.4 miles of relocated channel that removed natural meanders, resulting in a loss of 0.9 miles of total river length. This report indicated that as much as 68% of the entire St. Regis River had been altered prior to the construction of Interstate 90 (Alvord and Peters 1963). A report by the Superior Ranger District of the Lolo National Forest addressing probable impacts of the construction of Interstate 90 on the St. Regis River upstream of Saltese predicted an additional 0.4 miles of stream would be lost due to channel alterations (Howse 1969).

In 2002 and 2003, physical measurements were performed on the St. Regis River by UFSF and LWC to quantify existing conditions relative to sediment related impairments. A brief review of the results is presented below. Additional information can be found in the **Appendix E.**

The assessment of sediment impacts to stream habitat in the St. Regis River indicates there are two types of problems affecting beneficial use support (1) excess sediment loads and channel aggradation and (2) loss of sinuosity and channel degradation. Stream channels in naturally functioning systems tend toward a state of dynamic equilibrium with the amount of discharge and sediment load from the watershed. Sediment impacts within the St. Regis River can be described as a state of disequilibrium between the discharge, sediment load, and transport capacity of the stream channel. Sections of the stream channel that have been confined by riprap have increased transport capacities capable of flushing higher amounts of sediment through the system. These channelized reaches are characterized by entrenched channels with scour conditions in which sediment is rapidly transported downstream. The impact in these degrading reaches is the result of a high transport capacity relative to the sediment load. Sediment transported through channelized reaches is deposited and accumulates in lower gradient, unchannelized reaches. The impact in these aggrading reaches is the result of a low transport capacity relative to the sediment load, which results in excess sediment deposition in the form of bars, leading to braided channel conditions locally. Braided conditions are also characterized by lateral migration and accelerated bank erosion which is then producing more sediment.

Ten reaches of the St. Regis River delineated for assessment purposes were combined based on stream type and valley type to facilitate the following discussion. Stream reaches were numbered progressing upstream from the confluence with the Clark Fork River and assessments were conducted along 10% of each reach (**Table 5-7**).

Table 5-7. St. Regis River Reaches

Reach	Description	Stationing	Length (Feet)	Assessment Reach	Length (Feet)
1	Clark Fork River to Twomile Creek	0 - 23,300	23,200	16,500-18,800	2,300
2	Twomile Creek to Ward Creek	23,200 - 42,500	19,300	23,600-25,500	1,900
3	Ward Creek to Twelvemile Creek	42,500 - 68,500	26,000	65,400-68,000	2,600
4	Twelvemile Creek to Deer Creek	68,500 - 91,500	23,000	81,000-83,300	2,300
5	Deer Creek to Haugan	91,500 - 114,000	22,500	104,200-106,500	2,300
6	Haugan to Saltese	114,000 - 138,500	24,500	130,500-133,000	2,500
7	Saltese to Taft	138,500 - 162,100	23,600	142,000-144,400	2,400
8	Taft to Hanaker Creek	162,100 - 178,500	16,400	166,600-168,200	1,600
9	Hanaker Creek to Northern Pacific Railroad Grade	178,500 - 196,700	18,200	179,00-180,800	1,800
10	Northern Pacific Railroad Grade to St. Regis Lake	196,700 - 210,500	13,800	Not assessed	

Reaches 1, 4, and 5

Reaches 1, 4, and 5 contained Rosgen C-type channels flowing through a wide valley. Wide valleys with gentle slopes containing a meandering river with a well-developed floodplain and alluvial terraces characterized these reaches. Only one McNeil core sample was collected in these reaches due to an overall lack of appropriate spawning habitat. A McNeil core value of 20.5% <6.3 mm in reach 4 was meeting the water quality target of ≤28%. Riffle stability index values ranged from 81 to 93 in these three reaches, with all values exceeding the water quality target of <75, which suggests increased sediment loads (**Table 5-8**). Mid-channel bars and braiding within Reaches 1 and 5 also indicated aggrading conditions and a potential shift to a Rosgen D-type channel locally. The percent of sediment <2mm in riffles ranged from 0 to 16.0, meeting the water quality target of <20% at all locations. A grid-toss PSF value of 4.6 associated with the reach 4 McNeil core sample was meeting the target criteria of ≤8 in pool tail-outs. High bankfull width/depth ratios in these relatively unconfined reaches indicated excess sediment loads entering these sections, with 6 out of 7 measurements exceeding the supplemental indicator value of ≤30.

Since bankfull channel widths generally exceeded 45 feet in reaches 1, 4, and 5, a water quality target of 16 pools per mile applies, with measured pool frequency ranging from 9 to 63 pools per mile. Large woody debris was primarily associated with mid-channel bars in these reaches, though several large woody debris aggregates were found in reach 4. Overall, large woody debris ranged from 71 to 230 pieces per mile, with reaches 1 and 5 falling below the supplemental indicator criteria of at least 104 pieces of large woody debris per mile.

Sinuosity in these relatively unconfined reaches ranged from 1.08 to 1.20, with reaches 2 and 4 falling below the supplemental indicator of ≥1.2. In addition, riparian vegetation assessments found "non-functioning" conditions in reach 5, while reach 1 was "functioning-at-risk" and reach 4 was in "proper functioning condition".

Reaches 2, 3, 6 and 7

Reaches 2, 3, 6, and 7 contained Rosgen Bc and F-type stream channels flowing through steeper and more confined valleys found between Twomile Creek and Twelvemile Creek and between Haugan and Taft. Moderately steep valleys with moderately sloping hill sides that tend to confine the stream channel characterized reaches 2, 3, 6, and 7. These reaches are naturally somewhat confined, though the development of the transportation corridor has increased overall channel confinement and altered the St. Regis River into an entrenched Rosgen F-type channel along much of its length. Since the conversion from B to F stream types is anthropogenically induced, reaches with Rosgen F stream types will be assessed based on criteria for Rosgen B stream types. It may not be feasible to convert the Rosgen F channels back to B channels in many areas therefore these targets may be revised in the future.

Only one McNeil core sample was collected in reaches 2, 3, 6, and 7 due to an overall lack of appropriate spawning habitat. A McNeil core value of 19.2% <6.3 mm in reach 7 was meeting the water quality target of ≤28%. All riffle stability index values in these reaches were zero due to a lack of bars, which falls below the water quality goal of >45 and suggests scour conditions and high sediment transport capacities characterized these reaches (Kappesser 2002). Width/depth ratios exceeded the supplemental indicator criteria of ≤30 for in 6 out of 12 cross-sections. With a value of 7.6% in reach 3 and 8.6% in reach 6, the percent of sediment <2mm in riffles was meeting the water quality target of <20%. A grid-toss percent surface fines <6mm of 6.8 accompanying the reach 7 McNeil core samples was also meeting the target criteria of ≤8 in pool tail-outs.

Pool frequencies ranged from 0 to 126 pools per mile, generally falling below target values, which vary by stream width (Section 4). Similar to pool frequency, there was relatively little large woody debris in these reaches, with values of 4, 0, and 18 pieces per mile in reaches 3, 6, and 7, respectively. These values fall below the supplemental indicator. Large woody debris was not tallied in reach 2, though it was noted that a recent “blow-down” has knocked over numerous trees along the river left bank. These trees were found with their tops floating in the river and their roots still attached to the bank during the assessment, and will likely increase large woody debris inputs over time. The high stream energy in these segments transports wood to downstream bars in aggrading segments along with larger sized cobbles.

Sinuosity in reaches 2, 3, 6, and 7 ranged from 1.01 to 1.3 and was below the supplemental indicator of ≥1.2 in reaches 2, 6, and 7. Riparian assessments found “non-functioning” conditions in reaches 2 and 7, while reach 3 and 6 were “functioning-at-risk”.

Reaches 8, 9 and 10

Reaches 8, 9, and 10 extended upstream from Taft into the headwaters of the St. Regis River. Reach 8 contained a C channel in a moderately confined valley, while reach 9 contained a Cb channel in a glacial formed valley (Rosgen 1996). Reach 10 was located upstream of roaded development. Reach 8 was unconfined by the interstate along much of its length, though the section between the Rest Area and Taft was highly channelized. McNeil core samples collected at two sites in reach 8 exceeded the water quality target of ≤28% <6.3 mm at both sites with values of 28.1 and 37.3%. Grid-toss percent surface fines values of 10.5 and 17.9 accompanying the McNeil core samples also exceeded the target criteria of ≤8 in pool tail-outs. Percent surface fines <2mm ranged from 3 to 6, meeting the target at all locations. Riffle stability index values from reach 8 ranged from 64 to 75, equaling the upper water quality target of <75 at one site. Width/depth ratios in reach 8 exceeded the supplemental indicator value of ≤20 at all three locations.

The majority of reach 9 represented "least-impacted" conditions. However, the downstream end of reach 9 was channelized to accommodate Interstate 90 in which a high amount of traction sand delivery was estimated (see **Section 6.1**). The McNeil core sample collected upstream of this section slightly exceeded the water quality target of ≤28% <6.3 mm, while downstream of the channelized reach, a McNeil core value of 56.9% <6.3 mm greatly exceeded the water quality target. Similarly with the grid-toss percent surface fines values, with a value of 15.3 upstream of the channelized section and a value of 45.9 downstream of the channelized section. The percent surface fines <2mm exceeded the target of <20 at site C with a value of 26, but met the target at the other two sites where it was measured. A riffle stability index value of 46 from reach 9 was meeting the water quality target of >45 and <75. Width/depth ratios in reach 9, which was a Rosgen C3b stream type, exceeded the supplemental indicator value of ≤20 at two of three sites.

Pool frequency ranged from 23 to 114 pools per mile in reach 8, which were meeting the water quality target of at leant 16 pools per mile for Rosgen C stream types A total of 254 pools per mile were found in one measurement from reach 9, while a second value of "at least" 29 pools per mile was reported. A water quality goal of at least 16 pools per mile in this Rosgen C type stream reach appears to be met. A large woody debris measurement of 66 pieces per mile in reach 8 fell below the supplement indicator of at least 104 pieces per mile, while a large woody debris measurement of 15 pieces per mile in reach 9 fell below the supplemental indicator of at least 112 pieces per mile.

Both reaches 8 and 9 were rated as in "proper functioning condition." A sinuosity of 1.05 in reach 8 was below the supplemental indicator criteria of ≥1.2, while a sinuosity of 1.2 in reach 9 was meeting the criteria (**Table 5-8**).

Table 5-8. St. Regis River physical assessment data

Reach	Survey Reach	Cross-Section	Bankfull Width	Width / Depth Ratio	Stream Type	Sinuosity	Grid-toss PSF Lateral Scour Pools (mean)	Pebble Count % Surface Fines <2mm in Riffles	RSI	McNeil Core % Surface Fines <6.3mm	Pools / Mile	LWD/ Mile	PFC Assessment
1	LNF Hydro 7	A	210.6	57.2	C3	1.14		0.0			40		
1	LNF Hydro 7	B	143.0	29.3	C4	1.14		5.0	90				
1	LWC 1	reach-walk									11	73	FAR
2	LNF Hydro 6	A	83.0	27.3	F3	1.11		4.0	0		126		
2	LNF Hydro 6	B	76.3	21.9	F3	1.11		7.0					
2	LNF Hydro 6	C	71.8	19.8	F4	1.11		2.0					
2	LWC 2	reach-walk									3	blow down	FAR
3	LWC 3	A	85.9	40.9	F3	1.3							
3	LWC 3	B	79.1	39.6	F3	1.3		7.6	0		8	4	NF
3	LWC 3	C	91.7	48.3	F3	1.3							
4	LNF Hydro 4	A	83.5	36.2	C3	1.08		10.0			63		
4	LNF Hydro 4	B	106.0	57.2	C3	1.08		16.0	87				
4	LNF Hydro 4	C	91.8	43.5	C3	1.08		3.0					
4	LWC 4	reach-walk					4.6			20.5	21	230	PFC
5	LWC 5	A	114.2	67.2	C4	1.2			93				
5	LWC 5	B	100.5	55.8	C3	1.2		2.6	93		9	71	NF
5	LWC 5	C	133.0	63.3	C4	1.2			81				
6	LWC 6	A	56.0	31.1	F3	1.1							
6	LWC 6	B	62.1	38.8	F3	1.1		8.6	0		0	0	FAR
6	LWC 6	C	62.3	38.9	F4	1.1							
7	LNF Hydro 11	A	30.8	14.4	B3c	1.01		6.0	0		102		

Table 5-8. St. Regis River physical assessment data

Reach	Survey Reach	Cross-Section	Bankfull Width	Width / Depth Ratio	Stream Type	Sinuosity	Grid-toss PSF Lateral Scour Pools (mean)	Pebble Count % Surface Fines <2mm in Riffles	RSI	McNeil Core % Surface Fines <6.3mm	Pools / Mile	LWD/ Mile	PFC Assessment
7	LNF Hydro 11	B	29.7	13.3	B3c	1.01		6.0					
7	LNF Hydro 11	C	30.2	16.4	B3c	1.01		3.0					
7	LWC 7	reach-walk					6.8			19.2	18	18	NF
8	LNF Hydro 1	A	48.8	36.0	C4	1.05	3.1	27.0	64		114		
8	LNF Hydro 1	B	35.7	25.1	C4	1.05	17.9	15.0	71	37.3			
8	LNF Hydro 1	C	44.6	31.6	C4	1.05		26.0	75				
8	LWC 8	reach-walk					10.5			28.1	23	66	PFC
9	LNF Hydro 9	A	24.9	16.1	C3b	1.20		6.0			254		
9	LNF Hydro 9	B	27.3	20.1	C3b	1.20	45.9	23.0	46	56.9			
9	LNF Hydro 9	C	29.1	23.3	C3b	1.20		16.0					
9	LWC 9	reach-walk					15.3			31.8	29	15	PFC

5.8.2 Macroinvertebrates

Macroinvertebrate data were collected at four sites in the St. Regis River in 2001. At site C04STRGR01 the Mountain MMI was 78.8, meeting the supplemental indicator value of >63 for impairment, and the RIVPACS O/E score of 0.91 also met the supplemental indicator value of 1.2>RIVPACS>0.8. At site C04STRGR02 the Mountain MMI was 63.9, just meeting the supplemental indicator value of >63, while the RIVPACS O/E score was 0.65, failing to meet the supplemental indicator value of 1.2>RIVPACS>0.8. At site C04STRGR03 Mountain MMI was 63.2, just meeting the supplemental indicator value of >63, while the RIVPACS O/E score was 0.63, failing to meet the supplemental indicator value of 1.2>RIVPACS>0.8. At site C04STRGR04 Mountain MMI was 55.1, failing to meet the supplemental indicator value of >63, while the RIVPACS O/E score was 1.18, meeting the supplemental indicator value of 1.2>RIVPACS>0.8.

5.8.3 Periphyton

The 2001 DEQ periphyton bioassessment showed good biological integrity at each of four sites. However, siltation index values increased in a downstream direction, indicating increased sedimentation at the lower sample sites (Bahls 2002).

5.8.4 Fish Populations

Fisheries assessments contained in the Montana Interagency Stream Fishery database rated the St. Regis River as either “poor” or “below average” relative to its suitability for trout residence, spawning, and rearing. Problems were caused by a lack of spawning areas, low pool frequencies, siltation, and a lack of riparian vegetation. Problem sources included road construction, bank encroachment, channel alterations, and logging practices. The trend for aquatic habitat quality was rated as “deteriorating” and aesthetics were rated as “below average” (MFWP 1985, 1999). Fisheries have been assessed recently in the upper reaches where brook trout and cutthroat trout are the predominant game fish species (per. com. Knotek).

An assessment of bull trout habitat issues was prepared by Lolo National Forest fisheries biologists to satisfy consultation requirements of the federal Endangered Species Act. The report rated the St. Regis River as among the most important spawning tributaries for bull trout in the middle Clark Fork River basin, and indicated that it also supported resident bull trout populations of moderate to low densities. Bull trout were also reported to be present in the North Fork, South Fork, and mainstem Little Joe Creek, as well as Ward, Timber, and Big Creeks. Although recent fisheries data indicate that the only remaining bull trout populations in the watershed are likely in the Little Joe drainage (per. com. Knotek). Further, the St. Regis River was classified as bull trout “core area”, defined as drainages that currently contain the strongest remaining populations of bull trout, usually have relatively undisturbed characteristics and warrant the most stringent levels of protection because of their value as sources of stock for re-colonization. At the time of the report, both bull trout and Westslope cutthroat trout populations were described as “depressed” in the St. Regis River (Hendrickson and Cikanek 2000).

Risks to bull trout in the middle Clark Fork planning unit, of which the St. Regis River is a sub-watershed, include dams on the Clark Fork River that limit bull trout migrations, water quality degradation related to agricultural practices and timber harvest, illegal fish species introductions, fish management, mining, transportation systems, illegal harvest, and population trends. The report also provided analyses of watershed characteristics and land uses in the St. Regis watershed that directly or indirectly related to the above described risk factors. These included road densities and locations, past timber harvest, fish barriers, active and inactive mines, recreational uses, habitat indicators, and fish population status (Hendrickson and Cikanek 2000).

5.8.5 Temperature

The Lolo National Forest in cooperation with DEQ deployed two thermographs on the St. Regis River in 2001 from the middle of July to the middle of October near the mouth. The upper site was located upstream of Saltese and lower site was located at the USGS gaging station near the mouth. At the upper site, the 2001 temperature data documented a maximum temperature of 67.3°F on August 7. This value exceeded temperature limits for bull trout migration and rearing. There were a total of 41 days in which temperatures exceeded 59°F. The highest weekly maximum temperature (7DADMT) was 65.9°F. At the lower site, the 2001 temperature data documented a maximum temperature of 69.8°F on August 7. There were a total of 58 days in which temperatures exceeded 59°F at this site. The 7DADMT was 68.5°F. In 2002 and 2003, the temperature monitoring network was expanded. The maximum seven day average temperatures ranged from a low of 61.6°F at the USGS gage in 2002, to a high of 70.4°F at a site near Haugen in 2003 (Appendix D). At all monitoring locations in all years (2001-2003), the 7DADMT temperatures exceeded the temperature indicator.

Temperature conditions in the St. Regis River are much higher than temperatures expected. It is unclear if temperature conditions in the St. Regis River could meet bull trout rearing temperatures in the upper reaches or migration temperatures in the lower reaches in a naturally occurring condition where all reasonable land, soil, and water conservation practices are implemented, but the following paragraphs support the conclusion that temperatures could be reduced significantly from existing conditions with reasonable efforts.

Factors influencing stream temperature include solar radiation, the density of riparian vegetation, channel morphology, discharge, and stream aspect. Shade provided by riparian vegetation decreases the amount of solar radiation reaching the channel. A decrease in the canopy density along the stream channel can increase the amount of solar radiation reaching the stream channel, which leads to increased water temperatures (Hostetler 1991). Based on an analysis conducted in support of TMDL development (Appendix F), mean canopy density for the St. Regis River averages 30% along the river left bank and 50% along the river right bank. Thus, the overall mean canopy density along the St. Regis River is 40%, well below the 60% target value.

The riparian corridor along the St. Regis River competes with the transportation corridor for space upon the floodplain. Interstate 90 is primarily situated above the left bank along the north side of the river. Interstate 90 and the old railroad grade, which is located primarily along the right bank on the south side of the river, have effectively reduced the width of the riparian corridor, so that currently 50% of the river is bordered by a riparian corridor of less than 100 feet.

An extensive amount of stream bank alterations, stream channel alterations, and channel encroachment were documented along the St. Regis River. The vast majority of stream bank alterations were associated with the placement of rock riprap, which can negatively affect how the channel transports sediment and decrease the amount of shading riparian vegetation. Approximately 15.2 miles of riprap were measured along the St. Regis River. The left bank (facing downstream) contained approximately 10.5 miles of riprap, while the right bank had approximately 4.7 miles of riprap. A total of 7.4 miles of the documented riprap was associated with Interstate Placement of riprap along the stream bank during the construction of Interstate 90 resulted in approximately 2.8 miles of direct channel alterations at seven different sites (Appendix G). Riprap placed during the construction and maintenance of Highway 10, and the two railroads has affected 7.8 miles of the St. Regis River. Overall, stream bank alterations brought about through the development of the transportation corridor have led to channel encroachment problems along 12.4 miles of the river.

Although no direct linkage between these impacts and potential in-stream temperature increases has been established for the St. Regis River, analysis conducted for Twelvemile and Big Creeks (Appendix C) determined that riparian corridor impacts of lower magnitude than those found on St. Regis River have resulted in increases in stream temperature of more than 1°F, which violates state water quality standards. In light of the extensive alterations of the St. Regis River and high summer in-stream temperatures, there is little doubt that the river is impaired by temperature and thus a temperature TMDL will be developed.

5.8.6 St. Regis River Water Quality Status Summary

The St. Regis River is listed as impaired due to sedimentation/siltation, water temperature, and other habitat related listings. The existing data support the conclusion that sediment impairments exist within the St. Regis River. Upper sections have high fine sediment deposition. Other sections are over-widened and pool habitat has been filled from upstream sediment sources. Filling of pool habitats reduces fish rearing. Specific reaches are aggrading coarse sediment and other areas are degrading or transporting too much coarse sediment because of channel length losses and associated steepened gradients. It is estimated that since the freeway was built, some sections of the St. Regis River have degraded 6 feet or more. Channelization from transportation corridors has caused increased stream power to transport larger sized sediments than previously in many sections of the river. Significant human caused sediment sources are present in the watershed from forest roads, eroding banks, and traction sanding. Sediment delivery, transport, and deposition and in-stream sediment sorting have been impacted by human caused activity. Sediment conditions are likely impacting the fishery and aquatic insects. A sediment TMDL and habitat restoration plan will therefore be developed for the St. Regis River.

Data collected in 2001, 2002, and 2003 in support of TMDL-related temperature assessment of the St. Regis River found that at all sites in all years for which data are available, the 7DADMT exceeded the indicator values and summer temperatures routinely exceed bull trout migration tolerances. Furthermore, the extensive alteration of the river corridor and its riparian areas provides ample evidence that human activities have contributed to the elevation of temperature in the St. Regis River. A temperature TMDL will thus be developed for the St. Regis River.

SECTION 6.0 SEDIMENT

The St. Regis TPA sediment pollutant assessment focused on evaluating actual and potential sediment inputs from all identified sources, including an extensive forest road network, erosion from highway cutslopes, and the application of winter traction sand along Interstate 90. Additional sediment sources included eroding stream banks, storm water runoff from impervious surfaces, a variety of private and permitted public land use activities, the potential for catastrophic culvert failures, and natural sources. The sediment assessment also considered impacts associated with landscape scale and stream reach scale influences on stream energy, which affect sediment transport. Lastly, the potential for changes in basin water yield from silviculture or other activities was evaluated because it could impact stream channel morphology, stream bank stability, and sediment transport capacity of the mainstem St. Regis River and affected tributaries. Delivery of sediment from the above described potential source categories was analyzed through a combination of approaches, including review and interpretation of aerial photographs, field measurement of cut and fill slopes and traction sand deposits, culvert surveys, computer modeling, review of agency records and data, and in-stream indicators.

6.1 Sediment Source Assessment

This section provides:

- A description of the methodologies used to assess sediment sources in the St. Regis River watershed.
- A summary of the results of the sediment source assessment for all sediment-listed streams.
- TMDLs for all of the sediment-listed streams in the St. Regis River watershed.
- TMDL allocations and margin of safety for all of the sediment-listed streams in the St. Regis River watershed.

The term sediment is used in this document to refer collectively to several closely-related pollutants, including siltation, suspended solids, and sediment sources such as streambank erosion and riparian degradation that appear on Montana’s 303(d) Lists. The sediment TMDLs presented in this section are intended to address the sediment related 303(d) Listings.

6.1.1 Natural Background Sediment Load

The LoloSED computer model was used to analyze natural sediment production at the watershed scale including the HUC 6 tributary watersheds to the St. Regis River and the St. Regis HUC 5 **(Appendix H).** LoloSED is a sediment production model modified by the Lolo National Forest from the WATSED model, which was developed by the USDA Forest Service Region 1 and others (USDA 1991). Natural sediment production for the entire St. Regis 5^{th} field hydrologic unit (HUC 5) was estimated at approximately 2,400 tons/year based on the LoloSED model runs, or about 6.6 tons of sediment per square mile of watershed area per year **(Table 6-1)**. Background natural sediment production was estimated at 7.4 tons per square mile per year for the Little Joe Creek watershed, while rates for Ward, Twelvemile, Deer, and Big Creeks and the upper St. Regis mainstem were estimated at 6.6, 5.2, 6.4, 7.2, and 7.5 tons per year respectively. Future upland sediment modeling efforts should use other models for determining natural background erosion rates. LoloSED likely over predicts sediment loads. WEPP or RUSLE based models should be used for future upland based erosion assessments. No reductions in natural background sediment loading are called for in the sediment reduction allocations.

Table 6-1. LoloSED modeled natural sediment production in the St. Regis watershed

Watershed (5th & 6th code HUC #)	Natural Sediment Production (tons/year)	Area (sq mi)	Natural Sediment Production Normalized by area (tons/mi2/year)
St. Regis	2399	363	6.6
Big Cr (804)	273	38	7.2
Little Joe Cr (811)	319	43	7.4
Lower St. Regis_Mullan (812)	219	38	5.8
Twelvemile Cr (808)	310	60	5.2
Upper St. Regis (801)	306	41	7.5

6.1.2 Sediment Loading due to Timber Harvest

The LoloSED computer model was used to analyze sediment production due to timber harvest at the watershed scale, including the HUC 6 tributary watersheds to the St. Regis River and the St. Regis HUC 5 (Appendix H). Sediment production from timber harvest areas was determined using production coefficients for the logging system used (tractor, skyline, or helicopter) and natural sediment production values. Loading estimates assumed timber harvest levels remain static in the future. Based on LoloSED model projections for the years 1990-2020, sediment increases due to timber harvest peaked in the early 1990s at approximately 2,525 tons/year, or about 125 tons above the expected natural background levels. In 2003, timber harvest contributed an estimated 35 tons of sediment above the expected natural background levels (Appendix H). Sediment production in future years, through 2020, is expected to show a static trend. However, currently unplanned future harvest and road construction activities could increase sediment production beyond the projected levels. Future upland sediment modeling efforts should use other models for determining natural background erosion rates. LoloSED likely over predicts sediment loads. WEPP or RUSLE based models should be used for future upland based erosion assessments.

At these levels, sediment loading from timber harvest is not considered a significant anthropogenic source of sediment and thus load reductions are not proposed in the TMDLs and allocations that follow. However, currently unplanned future harvest and road construction activities could increase sediment production beyond the projected levels, and thus the careful application of BMPs to all future harvest-related activities is critical. Future upland disturbance associated with timber harvest, excluding associated roads should be kept below 5% of the TMDL for the water body. Future harvest planning should consider this threshold. No new sediment production from road building associated with timber harvest is allowed unless mitigated 2 to1 until the road allocations are met. No new sediment production should occur from near stream (300ft) timber harvest.

6.1.3 Sediment Loading due to Road Surface Erosion

The WEPP:Road model was used to estimate sediment loads from unpaved roads in the St. Regis TPA. The WEPP:Road model provides an estimate of sediment runoff from unpaved roads based on physical road characteristics, the soil type on which the road occurs and the climate. Physical road characteristics used in the model were measured in the field. Sediment loading from unpaved roads at the watershed scale for Big Creek, Little Joe Creek, Twelvemile Creek, and the St. Regis River was determined based on modeled sediment loads from both National Forest and non-federally managed lands. GIS analysis provided by the Lolo National Forest identified 621 unpaved road crossings on National Forest land in the St. Regis River watershed with 40 crossings in the Big Creek watershed, 83 crossings in the Little Joe Creek watershed, 30 crossings in the North Fork Little Joe Creek watershed, and 142 crossings in the Twelvemile Creek watershed. An additional 2 crossings were identified on non-federally managed lands in the Big Creek watershed, while 6 additional crossings were identified in the Twelvemile Creek watershed. In the St. Regis TPA, there are an estimated 52 crossings on non-federally managed lands. Total sediment loads from unpaved roads in the St. Regis TPA are estimated at 327.5 tons/year **(Table 6-2)**. Additional details on the road sediment assessment are presented in **Appendix I**.

To address this sediment source in the TMDLs and allocations that follow, the contributing segments of the roads were shortened to 200 feet in the model and used to estimate reasonable practices like diverting water from the road surface at points 100 feet from the stream crossing through vegetated buffers. Two hundred feet was selected as an example to illustrate the potential for sediment reduction by approximating BMP upgrades and is not a formal goal for all crossings. Although the modeled restoration analysis was used to estimate the potential for road sediment reduction, achieving this reduction in sediment loading from roads may be occur through a variety of methods such as diverting water from road surfaces, ditch BMPs and cut/fill slope BMPs.

Table 6-2. Sediment Loads from Unpaved Road Crossings in the St. Regis TPA

Watershed	Estimated Number of Unpaved Road Crossings	Total Sediment Load (Tons/Year)
Big Creek	42	21.1
Little Joe Creek	83	43.7
North Fork Little Joe Creek	30	15.8
Twelvemile Creek	148	74.9
St. Regis River	673	327.5

6.1.4 Potential Sediment Risk from Culvert Failures

Culvert failure may result in the direct discharge of road fill material into the stream channel. Undersized culverts are susceptible to failure or blow-out due to the ponding of water at the culvert inlet. Modeled discharge and the headwater depth (depth of water ponded at culvert inlet) to culvert depth ratio (Hw:D) was used by the Lolo National Forest to assess the risk of culvert failure (Appendix J). The magnitude of peak discharge (Q) for the 2, 5, 10, 25, 50, and 100-year stream flow recurrence intervals was modeled for each surveyed stream culvert crossing using regression equations developed by Omang (1992). Analysis of sediment risk from culvert failure was completed for 119 culverts. Surveyed culverts represented approximately 20% of the stream crossings present in the St. Regis watershed. Using the surveyed site results for certain sized flood events, the potential for existing loads from culvert failure was extrapolated to the watershed scale and normalized to an average yearly load over a century (**Table 6-3**). In the TMDLs and allocations that follow, sediment load reductions were derived by modeling the effects of upgrading culverts to safely pass the 100 year flood.

Table 6-3. Estimated Culvert Failure Sediment Loading

Watershed	Existing Total Average Annual Sediment Yield Potential (t/Y)	Total Average Annual Yield Potential (t/Y) for Q50 upgrade	% Reduction due to Q50 upgrades	Total Average Annual Yield Potential (t/Y) for Q100 upgrade	% Reduction due to Q100 upgrades
Big Creek	65.46	11.68	82	7.4	89
Little Joe Creek	344.06	112.22	67	39.6	88
Twelvemile	87.88	16.06	82	7.98	91
St. Regis	802.92	184.64	77	72.08	91

6.1.5 Sediment Loading from In-stream Sources

6.1.5.1 Bank Erosion

Eroding banks were assessed along the mainstem of the St. Regis River and several tributaries in 1996 and 2002 by the Lolo National Forest using R1/R4 methodology. The assessment by the Lolo National Forest of three reaches along the St. Regis River in 1994 and 1995 using the R1/R4 methodology found the percent of eroding banks ranged from 0-0.1%, while the same reaches had 0-0.2% eroding banks in 2002. Lolo National Forest inventories in 2002 indicated 3.7% eroding banks on Little Joe Creek, 0-1.1% on North Fork Little Joe Creek, 2.9% on East Fork Big Creek, and 14.9% eroding banks on West Fork Big Creek.

Visually eroding banks were assessed along 9 reaches of the St. Regis River during the physical habitat assessment conducted in 2003 by Land and Water Consulting. In addition, eroding banks in association with pools were assessed from the National Forest boundary to the St. Regis River confluence for Little Joe, Twelvemile, and Big creeks in 2002. During the physical assessment in 2003, 9 reaches covering 10% of the St. Regis River were looked at individually and only 2 or 3 reaches had any eroding banks. Eroding banks comprised minor portions of each of these reaches. However, there were several locations along the St. Regis River where large eroding banks were visible from the interstate and some sediment loading undoubtedly occurs from these sites during high flow events.

Visually eroding banks were assessed in association with pools in the lower reaches of Little Joe, Twelvemile, and Big Creeks in 2002. There was 0% eroding banks in Little Joe Creek, an average of 2.2% eroding banks in Twelvemile Creek, and an average of 61.5% eroding banks associated with pools in Big Creek.

In 2006, an additional assessment was conducted to quantify sediment loading from visually eroding banks (Appendix I). Streambank erosion assessments were performed on a total of 39 eroding streambanks, including 25 streambanks on the St. Regis River, 5 streambanks along Big Creek, 2 streambanks along Little Joe Creek, and 7 streambanks along Twelvemile Creek. Along the St. Regis River, stream bank erosion assessments were performed on eroding banks visible from Interstate 90 and the Frontage Road. Since Interstate 90 parallels the St. Regis River along the majority of its length, selection of sample sites through this technique was thought to capture all of the large eroding banks and the majority of smaller eroding banks. On tributary streams, eroding bank assessment sites were selected in the field based on observations made from the forest roads paralleling the stream channel, along with information from previous assessment work. Sections of Big Creek and Twelvemile Creek away from the road were walked, providing detailed coverage for these segments. Previous assessment work, along with local inquires, did not identify any other stream segments in the watershed in which streambank erosion was a significant source of sediment.

Streambank erosion was assessed by performing Bank Erosion Hazard Index (BEHI) measurements and estimating the Near Bank Stress (NBS) (Rosgen 1996, 2004). The BEHI score was determined at each eroding streambank based on the following parameters: bank height, bankfull height, root depth, root density, bank angle, and surface protection. BEHI categories range from “very low” to “extreme.” At each eroding streambank, the NBS was visually estimated for a bankfull flow event. NBS categories range from “very low” to “extreme.” The length, height, and composition of each eroding streambank were noted, and the source of streambank instability was identified based on the following near-stream source categories:

- Transportation
- Riparian Grazing
- Cropland
- Mining
- Silviculture
- Irrigation-shifts in stream energy
- Natural Sources
- Other

The source of streambank erosion was evaluated based on observed anthropogenic disturbances and the surrounding land-use practices. For example, an eroding streambank in an area affected by logging was assigned a source of “100% silviculture,” while an eroding streambank due to road encroachment upstream was assigned a source of “100% transportation.” If multiple sources were observed, then a percent was noted for each source, while naturally eroding streambanks were considered the result of “natural sources.” The “other” category was chosen when streambank erosion resulted from a source not described in the list. In the St. Regis TPA, observed sources of streambank erosion included transportation, cropland, silviculture, and natural sources. Estimated stream bank sediment loading rates for watersheds in need of a Sediment TMDL are provided in **Table 6-4**.

Table 6-4. Sediment Loads due to Eroding Streambanks in the St. Regis TPA by Source

Stream Segment	Stream Segment Length (Miles)	Sediment Load	Sources					Total Load
			Transportation	Cropland	Silviculture	Natural Sources	Other	
St. Regis River	38.6	Tons/Year	389.1	35.3	0.0	16.6	77.8	518.7
		Percent	75%	7%	0%	3%	15%	
Big Creek	3.4	Tons/Year	13.9	0.0	13.7	4.5	13.4	45.5
		Percent	30%	0%	30%	10%	30%	
Little Joe Creek	3.1	Tons/Year	0.0	0.0	36.4	0.0	0.0	36.4
		Percent	0%	0%	100%	0%	0%	
Twelvemile Creek	13.4	Tons/Year	42.2	0.0	2.3	3.3	0.0	47.8
		Percent	88%	0%	5%	7%	0%	

In the TMDLs and allocations that follow, a 90% reduction in the anthropogenic sediment load from bank erosion is proposed. This load reduction estimate is based on best professional judgment and use of the relationship between BEHI/near bank sheer stress and bank retreat rates on reference and nonreference banks. Reference conditions can be achieved in most locations via BMP application, restoration, and revegetation. In some cases however, the proximity of the existing road network, railroad, and other infrastructure may make achieving this reduction prohibitively expensive because the stream channel has been altered by bank armoring in the area, and the stream power is thus altered causing eroding banks nearby.

6.1.5.2 Historical Mass Wasting Sites

Sediment loading due to mass wasting was estimated for two large eroding hillslopes along the St. Regis River and two large eroding hillslopes along Twelvemile Creek using the Disturbed WEPP model. Input parameters for gradient, horizontal length, percent cover, and percent rock were derived through field data and a review of field photographs. In the TMDLs and Allocations that follow, no reduction in the sediment loading from mass wasting is proposed due to the relatively low contribution from the source and the difficulty that would be associated with stabilizing the mass wasting locations. Some natural attenuation of sediment loading from these sites will likely occur over time but there will be zero allocation to future human caused mass wasting events.

Table 6-5. Hillslope Inputs along the St. Regis River

Field Data		WEPP Results	Sediment Erosion from Hillslope (Tons/Year)
Stream Segment	Site	Average Sediment (Tons/Acre)	
St. Regis River	Hillslope 1	11.05	6.24
St. Regis River	Hillslope 2	13.91	3.74
Twelvemile Creek	BEHI 11	7.50	2.20
Twelvemile Creek	BEHI 12	9.19	1.20

6.1.6 Sediment Loading due to Winter Application of Traction Sand along Interstate 90

The input, storage, and transport of traction sand were examined along the St. Regis River adjacent to Interstate 90 (**Appendix K**). The storage and transport of traction sand were assessed based on the proximity of Interstate 90 to the stream channel and the movement of traction sand on Interstate fill slopes. Based on this analysis, it is estimated that 467 tons of traction sand are delivered to the St. Regis River during an average winter, which amounts to roughly 2.1% of the annual application rate of 21,778 tons of traction sand (**Table 6-6**). Sections of Interstate 90 within 100 feet of the stream channel are estimated to contribute 258 tons annually, delivery of traction sand through culverts is estimated to contribute 118 tons annually, and traction sand runoff from bridge decks is estimated to contribute 91 tons annually.

Table 6-6. Mean annual input of traction sand into the St. Regis River from Interstate 90

Source	Tons	Percent of Mean Annual Application Rate
Interstate within 100 feet of the channel	258	1.2%
Contribution through culverts	118	0.5%
Contributions from bridges	91	0.4%
Total	467	2.1%

The majority of the traction sand entering the stream channel is derived from two stretches of Interstate 90. Traction sand inputs within 25 feet of the stream channel for 2,900 feet (approximately 0.5 miles) from mile marker 2.0 to 2.6 (with mile marker 0 at the top of Lookout Pass) along the westbound lane accounts for approximately 147 tons, which is approximately 32% of the mean annual delivery rate (**Table 6-7).** A 10,200-foot (1.9 mile) stretch of road just upstream of Saltese, in which the interstate is within 50 feet of the stream channel from mile marker 8.0 to mile marker 10.0, contributes approximately 76 tons, which accounts for approximately 17% of the mean annual delivery rate. Thus, direct runoff from Interstate 90 along these two stretches of highway accounts for almost 50% of the total contribution of traction sand, while the other stretches of Intestate 90 within 100 feet of the stream channel account for approximately 35 tons, which is approximately 7% of the mean annual delivery rate. The remaining traction sand is contributed through culverts (25%) and from bridges decks (19%).

Table 6-7. Percent contribution of traction sand to the St. Regis River from Interstate 90

Source	Tons	Percent
Mile markers 2.0-2.6 and 8.0-10.0	223	48%
Other portions of I-90 within 100 feet of the channel	35	7%
Contribution through culverts	118	25%
Contribution from bridges	91	19%

Severe winter weather and mountainous roads in the St. Regis TPA will require the continued use of relatively large quantities of traction sand, and the close proximity of the St. Regis River to the road network will make significant reductions in loading difficult. The proposed 10% reduction in traction sand for the allocations that follow is based on ongoing efforts by the Montana Department of Transportation to incorporate BMPs into their winter sanding activities. These efforts may include a reduction in plowing speeds, improved maintenance and road sand recovery, and the increased use of chemical deicers as long as doing so does not crate a safety hazard or undue degradation to water quality. Additional BMPs may include improved vegetation buffers, routing flows away from streams, and the creation of sediment catching structures.

6.1.7 Sediment Loading due to Cutslope Erosion along Interstate 90

Potential sediment inputs from cutslope erosion were considered during the traction sand assessment (Appendix K). Forty-seven cutslopes were identified along Interstate 90 between St. Regis and Lookout Pass covering a linear roadside distance of 9.7 miles and an estimated area of 180.0 acres. The majority of cutslopes were located along reaches 2, 3, 6, and 7. Out of 38 culverts identified in the field, 21 of the culverts were associated with cutslopes and provided pathways to the stream channel. A total of 66 tons were estimated to be delivered to the St. Regis River annually from cutslope erosion.

A 10% reduction in sediment loading from I-90 cutslopes is proposed based on best professional judgment of the potential for stabilizing these slopes. A variety of techniques are available to improve cutslope stability; however, long-term stability typically depends on the establishment of vegetation, which will be difficult given the steep cutslopes and semi-arid climate. Additionally, BMPs may be utilized to prevent delivery of cutslope materials to the St. Regis River. As was the case with traction sand, these may include vegetation buffers, routing flows away from streams, and the creation of sediment catching structures.

6.1.8 Minor Sediment Sources

6.1.8.1 Changes in Water Yield

Increases in water yield as a result of land management activities and natural events has the potential to increase peak flows, which can alter stream channel morphology and increase stream bank erosion. Equivalent clear-cut area analysis was used to model residual water yield increases in the St. Regis watershed (Appendix L). Methods used for determining the effects of vegetation removal on water yield were developed specifically for the Lolo National Forest (Pfankuch 1973) and refined for U.S. Forest Service Region 1 (USDA 1976). Timber harvest activity on Lolo National Forest lands resulted in a projected 2.8% increase in water yield in the St. Regis River in 2003 as compared to natural background levels (**Table 6-8**). In addition, water yield increases in 2003 for the St. Regis River watershed are estimated at 0.8% due to the clear-cut corridor associated with forest roads. The overall water yield increase due to land management in the St. Regis River watershed is estimated at 3.6% for 2003.

Acceptable water yield increases, where adverse hydrologic and water quality effects would not be expected, are lower for highly erosive drainages and streams in poor condition than for drainages with stable soils and well functioning streams (Pfankuch 1973). These values range from about 8% for the former to 10-15% for the latter category. Increases in water yield due to timber harvest and road building currently exceed the 8% level in Twelvemile Creek and the Lower St. Regis River watershed.

Table 6-8. Percent water yield increase in 2003 due to land management activities

Watershed	Timber Harvest	Forest Roads	Overall
Big Creek	3.1	0.7	3.8
Little Joe Creek	4.2	0.9	5.1
Twelvemile Creek	6.2	1.9	8.1
St. Regis HUC5	2.8	0.8	3.6

The impacts of vegetation loss on water yield due to the 1910 fires in many of the tributary drainages to the St. Regis River had the potential for tremendous geomorphic effects. Predicted water yield increases resulting from the major wildfires of 1910 vary depending on the projected condition of the streams at that time. Water yield in the St. Regis watershed was projected to have increased by about 18.5% immediately after the fires, assuming that the river and its tributaries were not in excellent condition. According to the modeling results, it was not until the 1920s that water yield increases in the St. Regis watershed due to the fires dropped to below 10% over natural background levels. As of 2003 most (97%) of the area burned by the 1910 fires has recovered. However, the effects of the 1910 and other fires on channel morphology may persist today, in part due to activities that have further reduced and in many cases continue to reduce the stability of vulnerable stream channels attempting to recover from fire-induced water yield impacts. These activities include road encroachment, alteration by development of transportation corridors, and other activities such as timber harvest, particularly timber harvest or other clearing within riparian areas.

The combined effects of documented timber harvest and the 1910 fires have lead to greater than 8-10% water yield increases in four areas of the St. Regis watershed. These include the St. Regis headwaters area, Packer Creek, Twelvemile Creek, and the lower St. Regis River mainstem (Appendix L). Big Creek and Little Joe Creek were projected to have sustained roughly 5% increases in annual water yield during the 1970s and 1980s respectively. Water yield increases due to the combined effects of timber harvest and fire likely remained below 5% for all other tributaries and for the St. Regis watershed as a whole.

6.1.8.2 Storm Water Runoff from Impervious Surfaces

The Silver Dollar Bar parking lot in Haugen was examined relative to storm water runoff from impervious surfaces since it is one of the only large impervious surfaces in the watershed. The Silver Dollar Bar parking lot in Haugen was sloped inward and drained into a central collection area that did not appear to be connected to a stream channel. Thus, storm water runoff from the Silver Dollar Parking lot was determined not to be a significant source of sediment to the St. Regis River.

The amount of impervious surface due to Interstate 90 in the St. Regis watershed was calculated. Storm water runoff from Interstate 90 has the ability to transport significant quantities of sediment, as was previously discussed in the traction sand assessment. Interstate 90 and the associated drainage network of culverts likely increase the flashiness of storm water runoff, which may influence the size and timing of peak flows in the St. Regis River. Interstate 90 covered an estimated 363 acres of the St. Regis River watershed between Lookout Pass and St. Regis. This was a conservative estimate of impervious surface based on four 12-foot wide lanes and four 10-foot wide shoulders along 34 miles and did not account for unvegetated cut and fill slopes along the interstate. This was equivalent to 0.16% of the watershed.

6.2 Potential Sediment and Fisheries Habitat Influences.

6.2.1 Channel Alterations, Streambank Alterations and Channel Encroachment

Stream bank alterations, stream channel alterations, and channel encroachment associated with the construction and maintenance of two highways and two railroads are suspected to have influenced the hydrology, sediment transport capacity, water quality, and aquatic habitat features of the St. Regis River. Channel impacts associated with Interstate 90 were compared to preexisting impacts associated with the two railroads and Montana Highway 10 by examining aerial photographs from 1963-64, 1993, 1996, and 2000 along ten distinct reaches of the St. Regis River (Appendix G). Stream bank alterations, stream channel alterations, and road encroachment were also assessed along St. Regis River tributaries (Appendix M). The type of impact was categorized using the following criteria:

- **Stream bank alterations:** Structural practices such as riprap, jetties, and dikes used in an attempt to stabilize stream banks.

- **Stream channel alterations:** The straightening of meanders or cutting through of meander curves with a new channel of less distance than the original.

- **Channel encroachment:** An unnatural confinement or constriction of the stream channel and an accompanying loss of the stream's access to its natural floodplain and the extent of anthropogenic disturbances along the stream channel. Road density within 6th code HUC watersheds was used as one indicator of channel encroachment.

An extensive amount of stream bank alterations, stream channel alterations, and channel encroachment were documented along the St. Regis River. The vast majority of stream bank alterations were associated with the placement of rock riprap, which can negatively affect how the channel transports sediment on a site-specific and river-wide basis. Approximately 15.2 miles of riprap were measured along the St. Regis River (Appendix G). The left bank (facing downstream) contained approximately 10.5 miles of riprap, while the right bank had approximately 4.7 miles of riprap. A total of 7.4 miles of the documented riprap was associated with Interstate 90 (Appendix G). Placement of riprap along the stream bank during the construction of Interstate 90 resulted in approximately 2.8 miles of direct channel alterations at seven different sites (Appendix G). Riprap placed during the construction and maintenance of Highway 10 and the two railroads has affected 7.8 miles of the St. Regis River. Overall, stream bank alterations brought about through the development of the transportation corridor have led to channel encroachment problems along 12.4 miles of the river.

High road densities and road encroachment of stream channels within the St. Regis River watershed has led to stream bank alterations and channel encroachment on many of the tributary streams. Road densities between 1.7 and 4.7 miles of road per square mile are considered high by the U.S. Forest Service (USDA 1996). The overall road density is 2.8 in the St. Regis watershed, with road densities of 2.5 in the Little Joe and Big Creek watersheds and a road density of 3.4 in the Twelvemile Creek watershed (**Table 6-9**). There were 0.04 miles of riprap along Little Joe Creek, 0.03 miles of riprap along in the North Fork Little Joe Creek, and 0.25 miles along the South Fork Little Joe Creek (Appendix M). There were 0.78 miles of riprap along Twelvemile Creek and 0.44 miles of riprap along Big Creek. Most of the observed sections of riprap were associated with roads encroaching upon the stream channels. These sources affect fisheries habitat along with sediment production. Sediment production from these sources is assessed via the unpaved roads assessment, road sanding assessment, and bank erosion assessments mentioned above. Additionally the impacts caused by these human influences may affect sediment transport and sorting within the stream channels. The sediment targets and TMDLs combined effectively deal with sediment transport and deposition.

Table 6-9. Road-stream and road-watershed relationships characterized in Bull Trout baseline Section 7 Consultation study (Hendrickson and Cikanek 2000)

HUC 6 No.	HUC Name	Road Density (miles/ mile^2)	% Stream with Road w/in 300' of Stream	% Stream with Road w/in 125' of Stream	*Stream density
12	Lower St. Regis_Mullan +	3.6	37.3	19.8	2.6
8	Twelvemile Cr +	3.4	34.0	15.6	2.6
7	Twin Cr_St Regis	2.9	26.9	13.5	2.3
1	Upper St. Regis +	2.8	37.8	20.6	2.0
11	Little Joe Cr +	2.5	36.8	18.9	2.4
4	Big Cr +	2.5	36.6	12.8	1.6
	St. Regis 5th Code HUC	2.8	265.4	122.1	Not included

* Not part of Hendrickson and Cikanek 2000 analysis.

6.2.2 Noxious Weeds

The distribution of weeds was not determined during this assessment, though qualitative observations were made during field work. In general, invasive weeds can have a negative impact on the development of functioning riparian vegetation and the ability of riparian vegetation to trap sediment transported from upland sources. Invasive weeds lack the deep binding root mass characteristic to most riparian vegetation and are thus ineffective at stabilizing stream banks. The establishment of invasive weeds in riparian zones may lead to bank destabilization, which increases sediment inputs due to stream bank erosion. In areas where weeds out-compete riparian vegetation, the ability to buffer sediment laden runoff from the uplands is reduced. Fill slopes and roadside ditches along Interstate 90 that are covered with traction sand are also colonized by weeds in many cases. Fill slopes colonized by weeds are less effective than fill slopes colonized with grasses at preventing Interstate 90 runoff from reaching the stream channel.

6.3 Point Sources

Two recreation suction dredge permits (Wesley Gillespie, MTG370275; J.R. Merchant, MTG370278) authorize minor amounts of dredging in Ward Creek. MPDES recreation suction dredge permit activities are transitory and intermittent. Recreational suction dredging does not introduce new sediment load to the stream network. Instead, it transports the sediments that are already on the stream bottom and redeposits them. The MPDES permit process sets turbidity limits equal to Montana's water quality standards for turbidity. The MPDES permit process adequately considers water quality affects such as turbidity and sediment transport. Enforcing Montana's turbidity limits is protective of aquatic life and sediment transport capacity of the streams in the St. Regis watershed. Therefore, no sediment load allocation is provided for this activity because there are no new sediments introduced into the stream network, in-stream sediment transport is not accelerated significantly, and the potential water quality impacts associated with increased turbidity are addressed through the permit. Additionally, it should be noted that recreation suction dredging activities in Montana not only need a MPDES permit, but must also acquire a 310 permit which involves a fish biologist and local conservation district review for stream bed and fishery related impacts. The 310 permit process considers the timing of the activity, the physical habitat alteration, and impacts to incubating fish embryos and fry.

6.4 Future Development

Future developments within the St. Regis River watershed may have a negative impact on beneficial use support of coldwater fisheries and aquatic life. Potential future development includes timber harvest, road construction and maintenance, mining, subdivision development, and increased recreational pressure. Future developments should consider the potential negative impacts on coldwater fisheries and aquatic life. Negative impacts to be avoided include road or home building encroachment and the addition of riprap along stream banks, placement of culverts that act as fish passage barriers, and the removal of large woody debris and riparian vegetation in the stream corridors that provides stream shade. Other negative impacts with the potential to increase sediment and thermal loads may arise on a site specific basis. Future developments should proceed only after potential negative impacts to water quality have been addressed and mitigation plans developed.

6.5 Uncertainty

A degree of uncertainty is inherent in any study of watershed processes related to sediment. The approach used in this study to characterize sediment sources involves several techniques, each associated with a degree of uncertainty. It should be noted that some sediment source inventories may under- or over-estimate natural inputs due to selection of sediment source inventory reaches and the extrapolation methods used to derive water body wide sediment loading. Thus, the source assessment should not be taken as an absolutely accurate account of sediment production within each watershed but should be considered as a tool to estimate and make general comparisons of sediment loads from various sources. This TMDL document will include a monitoring and adaptive management plan to account for uncertainties in the source assessment.

Sediment loading varies considerably with season and by sediment source. For example, delivery increases during spring months when snowmelt delivers sediment from upland sources and resulting higher flows scour streambanks. However, these higher flows also scour fines from streambeds and sort sediment sizes, resulting in a temporary decrease in the proportions of deposited fines in critical areas for fish spawning and insect growth. Because both fall and spring spawning salmonids reside in the St. Regis River TPA, streambed conditions need to support spawning through all seasons. Therefore, sediment targets are not set for a particular season and source characterization is geared toward identifying average annual loads.

6.6 Total Maximum Daily Loads and Allocations

Based on the sediment source assessment, TMDLs and load allocations will be developed for each stream segment listed as impaired due to sediment in the St. Regis River TPA. A TMDL is the sum of waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources. In addition, the TMDL includes a margin of safety (MOS) that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving stream. A TMDL is expressed by the following equation:

$$TMDL = \Sigma WLA + \Sigma LA + MOS$$

This definition of a TMDL reflects the initial emphasis on controlling point source pollution in the history of water quality planning under the Clean Water Act of 1972. It is relatively simple to identify point sources and allocate a waste load allocation among these discrete contributors. In contrast, identifying and allocating pollution among diffuse nonpoint sources across the landscape is problematic, making strict application of this equation difficult given spatial extent of contributing sources and budgetary constraints.

The sediment TMDL process presented in the main document for the St. Regis River TPA will adhere to this TMDL loading function, but use an average annual sediment yield source assessment, a percent reduction in loading allocated among sources, and an inherent margin of safety. A percent reduction approach is used because there is uncertainty associated with the loads derived from the source assessment and using the estimated sediment loads creates a rigid perception that the loads are absolutely conclusive. The percent reduction TMDL approach constructs a plan that can be more easily understood for restoration planning. The total maximum daily loads for sediment are stated as an overall percentage of the sediment load that can be achieved by the sum of each individual allocation to a source. The sediment TMDLs use a percent reduction allocation strategy based on estimates of BMP performances in the watershed. Narrative performance based allocations may be used for smaller sources. An estimate of allowed daily sediment loads and daily allocations are provided in Appendix N.

The sediment load allocation strategy for the St Regis River TPA depends upon estimating the performance of reasonable restoration practices to reduce sediment loads entering streams. Sediment yield from roads are the broadest based and significant sources in the St. Regis watershed that are easily addressed through changes in current management. Performance based allocations will focus on the efficiency of BMPs to prevent sediment loading from specific source categories. BMPs for roads and other management practices are included in Section 8.

Some impacts are not as easily mitigated through changes in current management, can be very costly to restore, and are sometimes irreversible. Therefore, these sources of sediment will be addressed at an individual watershed scale established by best professional judgment based cost/benefit consideration to determine if restoration is reasonable according to State law.

6.6.1 Big Creek

6.6.1.1 Big Creek Source Assessment

Natural background sediment was estimated to be 273 tons/year. Forest roads and eroding stream banks contribute an estimated 21.1 and 45.5 tons/year respectively. The estimated annual sediment load from culvert failure is 65.5 tons/year. Modeling indicated that water yields are 3.8% above natural; however, this value is below thresholds at which excess sediment loading is thought to occur. Sediment loading from timber harvest, mass wasting, and traction sanding are all insignificant in the Big Creek Watershed.

6.6.1.2 Big Creek Sediment Allocations and Total Maximum Daily Load

The total maximum daily load (TMDL) for Big Creek is expressed as an overall 22% reduction in total sediment load. Sediment from natural background sources is beyond human control and is assumed to continue at rates estimated during the source assessment.

Of the 45.5 tons/year of sediment loading from eroding banks, 10% (4.5 tons/year) was determined to result from natural caused and is thus beyond human control **(Table 6-10).** For the remaining 41 tons/year, it is assumed that a 90% reduction in loading can be accomplished through a combination of BMP implementation and active restoration/stabilization. Sediment loading from potential culvert failure can be reduced by an estimated 89% by upgrading all culverts to safely pass the 100 year flood. Inevitably, some risk of failure will always remain, and this risk is reflected in the remaining 7.2 tons/year. There is no allocation to future human caused mass wasting although negligible loads from past events may persist. The sediment contribution from upland timber harvest disturbance is currently negligible but will be provided an allocation of approximately 5% of the overall TMDL. There are no point sources of sediment in the Big Creek Watershed; therefore, no waste load allocation is necessary.

Table 6-10. Sediment Allocations and TMDL for Big Creek

Sources		Current Estimated Load (Tons/Yr)	Performance Based Allocation - Change From Current Condition	Estimated Sediment Load Allocations (Tons/Yr)
Anthropogenic Nonpoint Sources	Forest Roads	21.1	- 48% (- 10.1 tons/year)	11.0
	Eroding Banks	45.5	- 80% (- 36.6 tons/year)	8.9
	Culvert Failure	65.5	- 89% (- 58.3) tons/year)	7.2
	Upland Timber Harvest	Negligible	Up to 5% of TMDL	15
Natural Background		273	Not applicable	273
Total Load		405	- 22% (- 90 tons/year)	315.1

6.6.2 Little Joe Creek

6.6.2.1 Little Joe Creek Source Assessment

Natural background sediment was estimated to be 319 tons/year. Forest roads and eroding stream banks contribute an estimated 43.7 and 36.4 tons/year respectively. The estimated annual sediment load from culvert failure is 344 tons/year. Modeling indicated that water yields are 5.1% above natural; however, this value is below thresholds at which excess sediment loading is thought to occur. Sediment loading from timber harvest, mass wasting, and traction sanding are all insignificant in the Little Joe Creek Watershed.

6.6.2.2 Little Joe Creek Sediment Allocations and Total Maximum Daily Load

The total maximum daily load (TMDL) for Little Joe Creek is expressed as an overall 45.5% reduction in total sediment load. Sediment from natural background sources is beyond human control and is assumed to continue at rates estimated during the source assessment. All of the sediment from eroding streambanks was determined to be the result of human impacts. It is assumed that a 90% reduction in loading can be accomplished through a combination of BMP implementation and active restoration/stabilization.

Sediment loading from potential culvert failure can be reduced by an estimated 88.5% by upgrading all culverts to safely pass the 100 year flood. Inevitably, some risk of failure will always remain, and this risk is reflected in the remaining 40 tons/year. There is no allocation to future human caused mass wasting although negligible loads from past events may persist. The sediment contribution from upland timber harvest disturbance is currently negligible, but will be provided an allocation of approximately 5% of the overall TMDL. There are no point sources of sediment in the Little Joe Creek Watershed; therefore, no waste load allocation is necessary.

Table 6-11. Sediment Allocations and TMDL for Little Joe Creek

<table>
<tr><th colspan="2">Sources</th><th>Current Estimated Load (Tons/Yr)</th><th>Performance Based Allocation - Change From Current Condition</th><th>Estimated Sediment Load Allocations (Tons/Yr)</th></tr>
<tr><td rowspan="4">Anthropogenic Nonpoint Sources</td><td>Forest Roads</td><td>43.7</td><td>- 48% (- 21.0 tons/year)</td><td>22.7</td></tr>
<tr><td>Eroding Banks</td><td>36.4</td><td>- 90% (- 32.8 tons/year)</td><td>3.6</td></tr>
<tr><td>Culvert Failure</td><td>344</td><td>- 88.5% (- 304.tons/year)</td><td>40</td></tr>
<tr><td>Upland Timber Harvest</td><td>Negligible</td><td>Up to 5% of TMDL allowed</td><td>20</td></tr>
<tr><td colspan="2">Natural Background</td><td>319</td><td>Not applicable</td><td>319</td></tr>
<tr><td colspan="2">Total Load</td><td>743.1</td><td>- 45.5%
(-337.8 tons/year)</td><td>405.3</td></tr>
</table>

6.6.3 North Fork Little Joe Creek

6.6.2.1 North Fork Little Joe Creek Source Assessment

Natural background sediment was estimated to be 182 tons/year. Forest roads and eroding stream banks contribute an estimated 24.9 and 20.7 tons/year respectively. The estimated annual sediment load from culvert failure is 196 tons/year. Modeling indicated that water yields are 5.1% above natural; however, this value is below thresholds at which excess sediment loading is thought to occur. Sediment loading from timber harvest, mass wasting, and traction sanding are all insignificant in the North Fork Little Joe Creek Watershed.

6.6.2.2 NF Little Joe Creek Sediment Allocations and Total Maximum Daily Load

The total maximum daily load (TMDL) for Little Joe Creek is expressed as an overall 45% reduction in total sediment load. Sediment from natural background sources is beyond human control and is assumed to continue at rates estimated during the source assessment. Load calculations in North Fork Little Joe Creek were developed based on the watershed's proportion of the greater Little Joe Watershed; no separate analysis was conducted. This approach was selected due to the relatively small size of the North Fork Watershed and its similarity to the greater Little Joe Watershed.

All of the sediment from eroding streambanks was determined to be the result of human impacts. It is assumed that a 90% reduction in loading can be accomplished through a combination of BMP implementation and active restoration/stabilization. Sediment loading from potential culvert failure can be reduced by an estimated 88.5% by upgrading all culverts to safely pass the 100 year flood. Inevitably, some risk of failure will always remain, and this risk is reflected in the remaining 22.5 tons/year. There is no allocation to future human caused mass wasting, although negligible loads from past events may persist. The sediment contribution from upland timber harvest disturbance is currently negligible, but will be provided an allocation of approximately 5% of the overall TMDL. There are no point sources of sediment in the North Fork Little Joe Creek Watershed; therefore, no waste load allocation is necessary.

Table 6-12. Sediment Allocations and TMDL for North Fork Little Joe Creek

Sources		Current Estimated Load (Tons/Yr)	Performance Based Allocation - Change From Current Condition	Estimated Sediment Load Allocations (Tons/Yr)
Anthropogenic Nonpoint Sources	Forest Roads	24.9	- 48% (12.0 tons/year)	12.9
	Eroding Banks	20.7	- 90% (18.6 tons/year)	2.1
	Culvert Failure	196	- 88.5% (173.5 tons/year)	22.5
	Upland Timber Harvest	Negligible	Up to 5% of TMDL allowed	11.4
Natural Background		182	Not applicable	182
Total Load		423.6	- 45% (192.2tons/year)	230.9

6.6.4 Twelvemile Creek

6.6.4.1 Twelvemile Creek Source Assessment

Natural background sediment was estimated to be 312 tons/year. Forest roads and eroding stream banks contribute an estimated 74.9 and 47.8 tons/year respectively. The estimated annual sediment load from culvert failure is 88.7 tons/year, and mass wasting was estimated to contribute an additional 3.4 tons/year.

Modeling indicated that water yields are 8.1% above natural. This value exceeds the 8% threshold at which increased water yields may begin to increase sediment loading. However the exceedance is so small that water yield will not be considered a separate source of sediment for purposes of the TMDL. The water yield analysis was completed in 2001 and little to no harvest has occurred since then, so the water yield is likely at or below the target. Any current increases in sediment loading that may have resulted from increased water yield (from increased stream power) should have be captured in the load estimate from eroding stream banks. Sediment loading from timber harvest and traction sanding are insignificant in the Twelvemile Creek Watershed.

6.6.4.2 Twelvemile Creek Sediment Allocations and Total Maximum Daily Load

The total maximum daily load (TMDL) for Twelvemile Creek is expressed as an overall 25% reduction in total sediment load. Sediment from natural background sources is beyond human control and is assumed to continue at rates estimated during the source assessment. The 48% reduction in sediment loading from forest roads was modeled based on the application of Best Management Practices (BMPs) that could reduce contributing road lengths to a maximum of 200 feet at each crossing (100 feet from either side).

Of the 47.8 tons/year of sediment loading from eroding banks, it is assumed that a 90% reduction in loading can be accomplished through a combination of BMP implementation and active restoration/stabilization (Table 6-13). Sediment loading from potential culvert failure can be reduced by an estimated 91% by upgrading all culverts to safely pass the 100 year flood. Inevitably, some risk of failure will always remain, and this risk is reflected in the remaining 8 tons/year.

No reduction in the sediment loading from mass wasting is proposed due to the relatively low contribution from the source and the difficulty that would be associated with stabilizing the mass wasting locations. Some natural attenuation of sediment loading from these sites will likely occur over time. There is no allocation to future human caused mass wasting although negligible loads from past events may persist. The sediment contribution from upland timber harvest disturbance is currently negligible, but will be provided an allocation of approximately 5% of the overall TMDL. There are no point sources of sediment in the Twelvemile Creek Watershed; therefore, no waste load allocation is necessary.

Table 6-13. Sediment Allocations and TMDL for Twelvemile Creek

Sources		Current Estimated Load (Tons/Yr)	Performance Based Allocation - Change From Current Condition	Estimated Sediment Load Allocations (Tons/Yr)
Anthropogenic Nonpoint Sources	Forest Roads	74.9	-48% (35.9 tons/year)	39
	Eroding Banks	47.8	-90% (43.4 tons/year)	4.4
	Culvert Failure	88.7	-91% (80.7 tons/year)	8.0
	Human Caused Mass Wasting	3.4	0% (0 tons/year)	3.4 decreasing to zero over time
	Upland Timber Harvest	Negligible	Up to 5% of TMDL allowed	20
Natural Background		312	Not applicable	312
Total Load		525.8	- 25% (140 tons/year)	386.8

6.6.5 St. Regis River

6.6.5.1 St. Regis River Source Assessment

Natural background sediment was estimated to be 2,399 tons/year. Sediment from timber harvest was estimated at 35 tons/year. Forest roads and eroding stream banks contribute an estimated 327.5 and 518.7 tons/year respectively. The estimated annual sediment load from culvert failure is 802.9 tons/year, and mass wasting was estimated to contribute an additional 9.98 tons/year. Traction sanding accounts for an estimated 467 tons/year, and eroding cutslopes along Interstate 90 contribute an additional 66 tons of sediment annually. Modeling indicated that water yields are 3.6% above natural; however, this value is below thresholds at which excess sediment loading is thought to occur.

6.6.5.2 St. Regis River Sediment Allocations and Total Maximum Daily Load

The total maximum daily load (TMDL) for the St. Regis River is expressed as an overall 27.5% reduction in total sediment load. Sediment from natural background sources is beyond human control and is assumed to continue at rates estimated during the source assessment. The 48% reduction in sediment loading from forest roads was modeled based on the application of Best Management Practices (BMPs) that could reduce contributing road lengths to a maximum of 200 feet at each crossing (100 feet from either side). Of the 518.7 tons/year of sediment loading from eroding banks, it is assumed that a 90% reduction in loading can be accomplished through a combination of BMP implementation and active restoration/stabilization (**Table 6-14**). Sediment loading from potential culvert failure can be reduced by an estimated 91% by upgrading all culverts to safely pass the 100 year flood. Inevitably, some risk of failure will always remain, and this risk is reflected in the remaining 72 tons/year.

No reduction in the sediment loading from mass wasting is proposed due to the relatively low contribution from the source and the difficulty that would be associated with stabilizing the mass wasting locations. Some natural attenuation of sediment loading from these sites will likely occur over time. There is no allocation to future human caused mass wasting although negligible loads from past events may persist. The sediment contribution from upland timber harvest disturbance is currently very low, but will be provided an allocation of approximately 5% of the overall TMDL.

Severe winter weather and mountainous roads in the St. Regis TPA will require the continued use of relatively large quantities of traction sand, and the close proximity of the St. Regis River to the road network will make significant reductions in loading difficult. The proposed 10% reduction is based on ongoing efforts by the Montana Department of Transportation to incorporate BMPs into their winter sanding activities. These efforts may include a reduction in plowing speeds, improved maintenance and road sand recovery, and the increased use of chemical deicers as long as doing so does not crate a safety hazard or undue degradation to water quality. Additional BMPs may include improved vegetation buffers, routing flows away from streams, and the creation of sediment catching structures.

A 10% reduction in sediment loading from I-90 cutslopes is proposed based on best professional judgment of the potential for stabilizing these slopes. A variety of techniques are available to improve cutslope stability; however, long-term stability typically depends on the establishment of vegetation, which will be difficult given the steep cutslopes and semiarid climate. Additional BMPs may be utilized to prevent delivery of cutslope materials to the St. Regis River. As was the case with traction sand, these may include vegetation buffers, routing flows away from streams, and the creation of sediment catching structures.

There are no permanent point sources that introduce sediment to the stream network in the in the St. Regis Watershed; therefore, no waste load allocation is zero. Recreational suction dredge permitted activities will be managed so that no new sediment is introduced into the stream network.

Table 6-14. Sediment Allocations and TMDL for St. Regis River

Sources		Current Estimated Load (Tons/Yr)	Performance Based Allocation - Change From Current Condition	Estimated Sediment Load Allocations (Tons/Yr)
Anthropogenic Nonpoint Sources	Forest Roads	327.5	-48% (157.2 tons/year)	170.3
	Eroding Banks	518.7	-90% (466.8 tons/year)	51.9
	Upland Timber Harvest	35	Up to 5% of TMDL allowed	165
	Culvert Failure	802.9	-91% (730.6 tons/year)	72.3
	Human Caused Mass Wasting	9.98	0% (0 tons/year)	9.98 decreasing to zero load over time
	Traction Sand	467.0	10% (476.3tons/year)	420.3
	I90 Cutslopes	66.0	10% (6.6 ton/year)	56.4
Point Sources	Recreational Suction Dredge Permits	0	0% (0 tons/year)	0
Natural Background		2,399	Not applicable	2,399
Total Load		4626.1	27.5% (1280.9 tons/year)	3345.2

6.7 Seasonality and Margin of Safety

All TMDL documents must consider the seasonal variability, or seasonality, on water quality impairment conditions, maximum allowable pollutant loads in a stream (TMDLs), and load allocations. TMDL development must also incorporate a margin of safety into the load allocation process to account for uncertainties in pollutant sources and other watershed conditions and must ensure (to the degree practicable) that the TMDL components and requirements are sufficiently protective of water quality and beneficial uses. This section describes the considerations of seasonality and a margin of safety in the St. Regis River TPA sediment TMDL development process.

6.7.1 Seasonality

Sediment loading varies considerably with season. For example, sediment delivery increases during spring months when snowmelt delivers sediment from upland sources and resulting higher flows scour streambanks. However, these higher flows also scour fines from streambeds and sort sediment sizes, resulting in a temporary decrease in the proportions of deposited fines in critical areas for fish spawning and insect growth. Because both fall and spring spawning salmonids reside in the St. Regis River TPA, streambed conditions need to support spawning through all seasons. Therefore, sediment targets are not set for a particular season and source characterization is geared toward identifying average annual loads.

6.7.2 Margin of Safety

An implicit margin of safety (MOS) is provided by conservative assumptions for sediment loading, which are designed to ensure restoration goals will be sufficient to protect beneficial uses. The margin of safety is to ensure that target reductions and allocations are sufficient to sustain conditions that will support of beneficial uses. An additional margin of safety is provided through an adaptive management approach that includes adjusting future targets and water quality goals based on monitoring outlined in Section 9. No explicit MOS is included in sediment TMDLs specified for each water body.

6.7.3 Future Growth and New Activities

There is potential for new sediment sources from future activities within the St. Regis watershed. Future actions in the watershed that could produce increased sediment loads or further disturb stream channel sediment transport capacity should demonstrate that associated sediment loading and fishery habitat alterations will not further degrade fish spawning and rearing in any of the watersheds with TMDLs. If the activities will increase sediment yields, a mitigation program approved by the DEQ may be considered.

6.8 Restoration Approach

Restoration recommendations focus primarily on addressing sediment inputs from roads, eroding banks, and potential culvert failure. The application of BMPs to unpaved roads, particularly at crossings and when the road parallels the stream channel, will provide a reduction in sediment loads once completed. Eroding streambanks can be addressed by best management practices and active restoration techniques that ultimately allow vegetation to recover. Load reductions derived from reduced streambank erosion due may take a decade to fully respond. Reductions from potential culvert can be achieved by upgrading culverts to accommodate the expected 100 year flood. See Section 8 of this document for a more detailed restoration approach.

6.9 Adaptive Management and Monitoring Recommendations

The adaptive management process allows for continual feedback on the progress of restoration activities and status of beneficial uses. Any component can be changed to improve ways of achieving and measuring success. Furthermore, the use of multiple lines of evidence (biological and physical) allow for a more robust measure of stream conditions. Because of the wide range of conditions present on listed water bodies and uncertainty regarding the connections between sediment targets and beneficial use support, monitoring of in-stream sediment targets should be part of the adaptive management plan to meet water quality goals. Effectiveness monitoring will include restoration progress tracking and also measuring sediment parameters to determine the effectiveness of restoration activities.

SECTION 7.0 TEMPERATURE

Total maximum daily loads are based on the loading of a pollutant to a water body. In the case of temperature thermal heating or loading is assessed. Federal Codes indicate that for each thermally listed water body the total maximum daily thermal load cannot be exceeded in order to assure protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife. Such estimates shall take into account the water temperatures, flow rates, seasonal variations, existing sources of heat input, and the dissipative capacity of the identified waters. Under the current regulatory framework for development of TMDLs, flexibility has been allowed for specifying allocations since *"TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure."* The main document of this TMDL does use other measures to fulfill requirements of Section 303(d) of the Clean Water Act. Although a loading capacity for heat is also estimated (e.g. kilocal/per day and per second), it is of limited value in guiding management activities needed to solve the identified nonpoint source temperature problems in the St. Regis Watershed and is therefore included in Appendix N. Development of surrogate allocations and an implicit margin of safety following U.S. EPA guidance (U.S. EPA, 1999) is appropriate for the main document in this case because a loading based approach would not provide additional utility and the intent of the TMDL process is achieved by using other appropriate measures because there are no point sources that affect heat in the watershed.

Modeling results provided much of the technical framework for developing a surrogate-based temperature TMDL and allocation approach (Appendix C). Influences to instream temperatures are not always intuitive at a watershed scale and the modeling helped estimate the relative effects that stream shading, channel geometry, and stream flow have on temperature during the hottest time of year. Field assessment data and best professional judgment from a team of professionals are also incorporated into the temperature allocation process because there are inherent uncertainties and assumptions associated with modeling results.

The surrogate based temperature TMDLs will result in thermal loading reduction necessary to obtain compliance with Montana's temperature water quality standards. The applicable standard for the temperature limited streams in the St. Regis Watershed are a 1ºF increase above naturally occurring temperatures during timeframes that are naturally below 67ºF. Modeling indicated that naturally occurring temperatures are below 67ºF. The allocation for thermal load reduction will be expressed as a surrogate measurement in this section of the main document because restoration approaches tie into this strategy. TMDLs and Instantaneous Thermal Loads (ITLs) are provided numerically (kilocal/day, kilocal/sec) in Appendix O. The surrogate for thermal loading is:

- The percent change in effective shade that will achieve reference potential, applied to the sources that are currently limiting shade.
- Reduction in bankfull width to depth ratio of St. Regis River's channel geometry.

7.1 Big Creek Temperature Allocations and Total Maximum Daily Load

Shade assessments conducted in the Big Creek Watershed identified potential reference conditions in the upper Middle and East Forks of Big Creek and in the upper mainstem. Least impacted reaches of the tributaries averaged 71% daily shade as measure by a Solar Pathfinder, while in the upper mainstem daily shade averaged 52%. These values will serve as the basis of TMDL surrogate temperature allocations in the watershed, with the tributary values applied to steep forested reaches and the mainstem values applied to higher order and/or naturally shrub dominated reaches.

Development of a temperature TMDL and allocations for Big Creek identify human activities that influence the surrogate temperature factors. The allocations indicate the relative change needed for each temperature influencing factor that, in combination, will likely achieve Montana's temperature standards (Table 7-1). This conclusion is supported by modeling results that demonstrate the connection between increased stream shading and decreased in-stream temperatures. This approach allows for prioritization of restoration activities for meeting water quality standards through an adaptive approach informed by long-term monitoring. Information presented in Table 7-1 allows for a surrogate based allocation strategy. The allocations may be refined or modified with additional data collected through an adaptive management approach (Section 9.0). Appendix O contains a numeric temperature TMDL and allocation approach.

Table 7-1. Surrogate Temperature Allocations for Big Creek

Temperature Surrogates	Location	Reference % Shade	Current Average % Shade	Allocation	Human Influences
Effective Shade (Surrogate)	Tributaries with conifer canopy	71	?	Increase average daily shade	Road encroachment Historic logging
	Upper Middle Fork[1] BG01	71	62	Increase average daily shade by 9%	Historic logging
	Lower Middle Fork BG02	52	18	Increase average daily shade by 34%	Road encroachment Historic logging
	Upper East Fork[1] BG03	71	63	Increase average daily shade by 9%	Historic logging
	Lower East Fork BG04	71	36	Increase average daily shade by 35%	Road encroachment Historic logging
	Upper West Fork BG05	71	21	Increase average daily shade by 50%	Historic logging Localized channel widening
	Middle West Fork BG06	71	42	Increase average daily shade by 29%	Road encroachment
	Lower West Fork BG07	52	23	Increase average daily shade by 29%	Road encroachment Historic logging Localized channel widening[2]
	Upper Mainstem BG08 (1&2)	52	52	Increase average daily shade by 0%	Road encroachment Localized channel

Table 7-1. Surrogate Temperature Allocations for Big Creek

Temperature Surrogates	Location	Reference % Shade	Current Average % Shade	Allocation	Human Influences
					widening
	Lower Mainstem BG08 (3)	52	24	Increase average daily shade by 28%	Channel widening and bank stability impacts

1. Reference data taken from least impacted portions of these reaches.
2. No surrogate allocation is provided for channel widening because modeling indicated that channel dimensions are not impacting temperatures significantly.

7.2 Twelvemile Creek Temperature Allocations and Total Maximum Daily Load

Shade assessments conducted in the Twelvemile Creek Watershed identified potential reference conditions. Least impacted headwaters reaches averaged 89% daily shade as measure by a Solar Pathfinder, middle reaches in semi confined valleys averaged 65% and had some impact from the road which considers the road as a permanent impact during the allocation process, and lower reaches near the mouth averaged 52%. These values will serve as the basis of TMDL surrogate temperature allocations in the watershed.

Development of a temperature TMDL and allocations for Twelvemile Creek identify human activities that influence the surrogate temperature factors. The allocations indicate the relative change needed for each temperature influencing factor that, in combination, will likely achieve Montana's temperature standards (Table 7-2). This conclusion is supported by modeling results that demonstrate the connection between increased stream shading and decreased in-stream temperatures. This approach allows for prioritization of restoration activities for meeting water quality standards through an adaptive approach informed by long-term monitoring. Information presented in Table 7-2 allows for a surrogate based allocation strategy. The allocations may be refined or modified with additional data collected through an adaptive management approach (Section 9.0). Appendix N contains a numeric temperature TMDL and allocation approach.

Table 7-2. Temperature Allocations for Twelvemile Creek

Temperature Surrogates	Location	Reference % Shade	Current Average % Shade	Allocation	Human Influences
Effective Shade (Surrogate)	Tributaries with Tree dominated canopy	89%	?	Increase average daily shade	Timber harvest Road encroachment Power Lines
	Headwaters TM01	89[1]	89	Increase average daily shade by 0%	Minimal impacts
	Headwaters TM 02	89	59	Increase average daily shade by 30%	Timber harvest Road encroachment

Table 7-2. Temperature Allocations for Twelvemile Creek

Temperature Surrogates	Location	Reference % Shade	Current Average % Shade	Allocation	Human Influences
	Middle TM 03	65[1]	65	Increase average daily shade by 0%	Minimal impacts w/ limited road encroachment
	Middle TM 04	65	58	Increase average daily shade by 8%	Channelization Power Lines Recreation
	Lower TM 05	52	24	Increase average daily shade by 28%	Road encroachment Timber Harvest Housing/Lawn/ Aesthetic Clearing
	Lower TM 06	52[1]	52	Increase average daily shade by 0%	Minimal impacts

1. Reference data taken from least impacted portions of these reaches.

7.3 St. Regis River Temperature Allocations and Total Maximum Daily Load

As discussed in Section 4.0, a canopy coverage supplemental indicator of ≥60% has been selected for the St. Regis River. A width to depth ratio supplemental indicator has also been set for the St. Regis at ≤22 for Rosen B channel reaches and ≤33 for Rosgen C channel reaches. These supplemental indicator values will serve as surrogates for temperature in the allocation and TMDL for the St. Regis River.

Development of a temperature TMDL and allocations for the St. Regis River identify human activities that influence the surrogate temperature factors. The allocations indicate the relative change needed for each temperature influencing factor that, in combination, will likely achieve Montana's temperature standards (Table 7-3). The surrogate shade allocation to tributaries uses the average reference condition from Big and Twelvemile Creeks. This approach allows for prioritization of restoration activities for meeting water quality standards through an adaptive approach informed by long-term monitoring. Information presented in Table 7-3 allows for a surrogate based allocation strategy. The allocations may be refined or modified with additional data collected through an adaptive management approach **(**Section 9.0**)**.

Table 7-3. Temperature Allocations for the St. Regis River

Temperature Surrogates	Location	Goal	Current Average	Allocation	Human Influences
Percent Shade (Surrogate)	Tributary Reaches with Potential for Conifer Canopy	≥80%	?	Increase average canopy density	Road encroachment Historic Logging Housing/Lawn/Aesthetic Clearing Power Lines
	Tributary Reaches with Potential for Shrub Canopy	≥58%	?	Increase average canopy density	Road encroachment Housing and Cabin Development
Canopy Cover (Surrogate)	Mouth to Twelvemile Creek	≥60%	32	Increase average canopy density by 28%	Road Encroachment Railroad Encroachment Riprap Channelization Land clearing Power Lines
	Twelvemile Creek to Saltese	≥60%	42	Increase average canopy density by 18%	
	Upstream of Saltese	≥60%	44	Increase average canopy density by 16%	
Width/Depth Ratio	St. Regis River Below Haugan	≤30	Range of 14.7-40.1	Decrease average W/D ratio on C and F channels by 10.1	

7.4. Additional Surrogate Allocation Components for the St. Regis Watershed

Any new areas of clearing stream shade influencing vegetation within any of the temperature limited watersheds is not consistent with the TMDL allocation until surrogate allocations are met or it can be determined that the numeric TMDLs in Appendix O are met. A thermal trading system is also not appropriate until surrogate allocations are met or it can be determined that the numeric TMDLs in Appendix O are met. If activities that reduce shade are absolutely necessary, mitigation on a 2 to 1 basis should occur if the standard and TMDLs have not been met for the watershed. A trading system may be instituted after Montana's temperature standards are met. If any new riparian vegetation thinning is considered, it is the thinning party's responsibility to prove that short term impacts are overcome by long term benefits to stream shade.

7.5 Seasonality and Margin of Safety

All TMDL/Water Quality Restoration Planning documents must consider the seasonal variability, or seasonality, on water quality impairment conditions, maximum allowable pollutant loads in a stream (TMDLs), and load allocations. TMDL development must also incorporate a margin safety into the load allocation process to account for uncertainties in pollutant sources and other watershed conditions, and ensure (to the degree practicable) that the TMDL components and requirements are sufficiently protective of water quality and beneficial uses.

This section describes in detail considerations of seasonality and a margin of safety in the temperature TMDL development process.

7.5.1 Seasonality

Seasonality addresses the need to ensure year round beneficial use support. The TMDL should include a discussion of how seasonality was considered for assessing loading conditions and for developing restoration targets, TMDLs and allocation schemes, and/or the pollutant controls. Seasonality is addressed in this TMDL document as follows:

- Temperature conditions were monitored by data logging devices during a range of seasons over a number of years.
- Temperature modeling simulated heat of the summer conditions when instream temperatures are most stressful to the fishery. The fishery is the most sensitive use in regard to thermal conditions.
- Temperature targets apply year round but are most applicable to summer conditions.
- Restoration approaches will help to stabilize stream temperatures year round.

7.5.2 Margin of Safety

The margin of safety may be applied implicitly by using conservative assumptions in the TMDL development process or explicitly by setting aside a portion of the allowable loading (U.S. EPA, 1999). The margin of safety is addressed in several ways as part of this document:

- Montana's water quality standards are applicable to any timeframe and any season. The temperature modeling analysis investigated temperature conditions during the heat of the summer during the most likely timeframe when the temperature standards are most likely exceeded.
- Targets provide guidance on both temperature conditions in relation to state temperature standards and to surrogate measures that will influence temperatures.
- Surrogate based TMDL allocation approaches are provided in the main document. Numeric heat load TMDLs and an Instantaneous Thermal Loads are provided in Appendix O.
- Montana has also built an inherent margin of safety into the State's temperature standards. In effect, Montana's standard for B1 streams incorporates a combined load allocation and wasteload allocation equal to 0.5-1°F depending on naturally occurring temperature conditions at any time of the year. This small shift in allowed temperature increase will protect all beneficial uses in the St. Regis Watershed and, if the three load reduction approaches provided in this document are followed, should equate to cooler water in the St. Regis watershed.
- Compliance with targets and refinement of load allocations are all based on an adaptive management approach that relies on future monitoring and assessment for updating planning and implementation efforts.

7.6 Restoration Schedule

Restoration recommendations focus on increasing riparian shade. Significant time is needed for riparian vegetation re-growth. Different riparian vegetation communities will take different amounts of time to grow after riparian BMPs or appropriate riparian management have emplaced. Load reductions derived from such an approach may take a decades to fully respond because of vegetation growth timeframes. See Section 8.0 of this document for a more detailed temperature restoration approach.

7.6.1 Monitoring Recommendations and Adaptive Management Plan

Shade monitoring for further apportioning shade impacts to specific sources may be needed to refine restoration actions in specific areas. Future monitoring and modeling may be necessary to determine restoration goals and TMDL compliance.

8.0 RESTORATION STRATEGY

8.1 Introduction

This section presents the overall strategy to achieve water quality restoration and meet water TMDL targets and load reductions. The restoration of water quality and habitat conditions in the St. Regis TPA could be achieved through a variety of management and restoration actions, and, in general, this document provides conceptual recommendations leaving the specific details to local stakeholders. A time element for restoration activities is not included in the document because most restoration projects rely upon public funding programs, local and private funding match, local efforts to apply for funds, and landowner participation. The following are the primary basin-wide objectives of this water quality restoration project. These goals would be achieved through implementation efforts outlined in this restoration strategy:

- Ensure full recovery of aquatic life beneficial uses to all impaired and threatened streams identified by the State of Montana within the St. Regis TPA
- Avoid conditions where additional water bodies within the St. Regis TPA become impaired
- Work with landowners and other stakeholders in a cooperative manner to ensure implementation of water quality protection activities
- Continue to monitor conditions in the watershed to identify any additional impairment conditions, track progress toward protecting water bodies in the watershed, and provide early warning if water quality starts to deteriorate

8.2 Agency and Stakeholder Coordination

Achieving the targets and allocations set forth in this plan will require a coordinated effort between land management agencies and other important stakeholders, including county governments, conservations districts, private landowners, state and federal agency representatives, and individuals from conservation, recreation, and community groups with water quality interests in the St Regis River Watershed. DEQ would support a stakeholder group that could foster water quality restoration efforts that generally follow restoration recommendations of this document.

8.3 General Management Recommendations

Forest roads, road sanding, potential culvert failure, eroding streambanks, and stream shade reduction via any human activities are currently the primary human caused sources of impairment to water quality in the St Regis watershed. Natural sources are also significant and surpass all other source categories combined. Past management influences such as large-scale riparian clearing, highway and rail line encroachment, riprap, and other channel alterations have had a large influence on the character of the listed water bodies, but these influences are not as easily mitigated through reasonable soil, land, and water conservation practices. Where feasible, these past impacts are also addressed in restoration priorities.

General management recommendations are outlined for major sources of pollutants in the St. Regis Watershed. Best Management Practices form the foundation of the management recommendations but are only part of the restoration strategy. Recommendations may also address evaluating current use and management practices. In some cases a larger effort than implementing new BMPs may be required to address sources of impairment. In these cases BMPs are usually identified as a first effort, and an adaptive management approach will be used to determine if further restoration approaches are necessary to achieve all beneficial uses. Monitoring will also be an important part of the restoration process. Monitoring recommendations are outlined in Section 9.0.

8.4 Implementation Strategies and Recommendations by Source Type/Category

8.4.1 Forest Roads.

The analysis conducted as part of TMDL development indicated there are approximately 673 unpaved road crossings in the St. Regis River watershed, with 42 crossings in the Big Creek watershed, 83 crossings in the Little Joe Creek watershed, 30 crossings in the North Fork Little Joe Creek watershed, and 148 crossings in the Twelvemile Creek watershed. Total sediment loads from unpaved roads in the St. Regis TPA are estimated at 327.5 tons/year (**Appendix I**). Through the application of BMPs, it is estimated that the sediment load could be reduced by 48%. This road sediment reduction represents the estimated sediment load that would remain once all contributing road treads, cut slopes, and fill slopes were reduced to the maximum of 200 feet. Two hundred feet was selected as an example to illustrate the potential for sediment reduction through BMP application and is not a formal goal. Achieving this reduction in sediment loading from road may be occurring through a variety of methods at the discretion of local land managers and restoration specialists:

- A localized implementation team should prioritize sediment contributing road sections and stream crossings for upgrading and sediment load mitigation, including potential road decommissioning. Specific locations and methods of sediment reduction will be left to the judgment of local land managers. This process should be pursued as a coordinated effort so that total road sediment reductions can be tracked in a consistent manner.
- Assessments should occur for roads within watersheds that experience timber harvest or other major land management operations. The information gathered during these assessments will allow for timely feedback to land managers about the impact their activities could have on water quality and achievement of TMDL targets and allocations. This feedback mechanism is intended to keep sediment load calculations current and avoid impacts that go undetected for an extended period of time.

8.4.2 Culvert Failure

Analysis of sediment risk from culvert failure was completed for 119 culverts (**Appendix J**). Surveyed culverts represented approximately 20 percent of the stream crossings present in the St. Regis watershed. Using the surveyed site results for certain sized flood events, the potential for existing loads from culvert failure was extrapolated to the watershed scale and normalized to an average yearly load over a century. The estimated potential annual sediment load from culvert failure was across the watershed was significant.

In the TMDLs and Allocations in **Section 6**, sediment load reductions were derived by modeling the effects of upgrading culverts to safely pass the 100 year flood. As part of this restoration plan, a local implementation team could prioritize culverts for restoration. This prioritization should begin by conducting an analysis of the remaining 80% of the culverts in the TPA. Once all culverts have been analyzed, they can be prioritized for restoration, replacement, or removal based on the risk of failure, the amount of sediment loading from failure, and the level of disturbance associated with culvert replacement or upgrade.

8.4.3 Traction Sanding

Severe winter weather and mountainous roads in the St. Regis TPA will require the continued use of relatively large quantities of traction sand, and the close proximity of the St. Regis River to the road network will make significant reductions in loading difficult. Nevertheless, the Montana Department of Transportation (MDT) incorporates best management practices into their sanding efforts, and these may be applied to reduce loading to streams to the extent practicable. These BMPs may vary from area to area, but in the St. Regis TPA may include the following:

- Reduce the speed of plowing to decrease the distance that snow/sand mix is blown away from the highway
- Increase the use of chemical deicers and decrease the use of road sand, as long as doing so does not create a safety hazard or cause undue degradation to vegetation and water quality
- Improve maintenance records to better estimate the use of road sand and chemicals, as well as to estimate the amount of sand recovered in sensitive areas
- Continue to fund and manage MDT research projects that will identify the best designs and procedures for minimizing road sand impacts to adjacent bodies of water and incorporate those findings into additional BMPs
- Work with county road agents to share information and state-county road BMPs
- Identify areas with poor soil cover and explore options for revegetation to promote the growth of non-invasive species

8.4.4 Interstate 90 Cutslopes

A variety of techniques are available to improve cutslope stability; however, long-term stability typically depends on the establishment of vegetation, which will be difficult given the steep cutslopes and arid climate. Additionally, BMPs may be utilized to prevent delivery of cutslope materials to the St. Regis River. As was the case with traction sand, these may include vegetation buffers, routing flows away from streams, and the creation of sediment catching structures.

8.4.5 Stream Corridor Restoration

The TMDL planning effort identified numerous conditions along stream corridors throughout the TPA that affect sediment loading, in-stream temperatures, riparian health and function, fish habitat, and geomorphic stability. These include conditions such as eroding banks, encroachment of structures, roads, and rail lines on streams and their floodplains, riparian degradation, riprap, infestation of noxious weeds, and the presence of fish passage barriers. This section provides general prescriptions to address these conditions throughout the St. Regis TPA.

Channel straightening

Stream channels have been straightened in many areas of the St Regis watershed for several purposes related primarily to roads. Channel straightening should be avoided in future management. Restoration approaches that remediate straightened channels, which are sediment sources, are considered on a stream-by-stream basis, but associated costs and benefits should be weighed. Any future projects that require stream channel construction or channel realignment should consider natural channel designs.

Revegetation

The revegetation of eroding streambanks, and cleared or impacted riparian and floodplain areas with native vegetation will reinforce and anchor stream banks and over bank surfaces. In general, woody riparian understory species are most effective at generating root masses that effectively resist erosion, while large trees are most desirable for large woody debris and shade. Vegetated riparian banks also act to filter and hold fine sediment during periods of high flows.

Riparian Buffers

The implementation of a riparian buffer zone to limit stream encroachment from vegetation clearing and development can facilitate the management of the stream system as a channel/floodplain corridor rather than simply as a channel environment. Riparian buffers can also facilitate the growth of overstory trees, which function as a source of large woody debris and provide shade to the channel. A local implementation team is encouraged to work with county government to develop and implement consistent policies on appropriate setbacks from streams including:

- Establishing a minimum riparian buffer from the floodplain for all habitable structures to allow for natural channel migration and avoid the need for shoreline armoring to protect structures built too close to the migrating channel
- Providing technical assistance to county commissions and conservation districts in developing maps that delineate the riparian buffer and creating a process for landowner setback exceptions
- Encouraging riparian BMPs for vegetation management within the riparian buffer to promote long-term riparian health and avoid erosion and sedimentation

Riparian Grazing BMPs

This watershed currently does not have high grazing pressure, but limited grazing occurs. Streamside areas provide high quality forage for livestock, and these areas often sustain impacts in the absence of effecting management. This plan calls for implementation of grazing best management practices to restore the structure and function of riparian communities. The implementation/restoration team or NRCS can serve as a clearing house for technical assistance and educational support to landowners wanting to avoid degradation and bank trampling. Specific BMPs may include:

- Temporary exclusions where impacts are sever enough that several years of rest is required

- Placement of riparian areas in conservation easements for extended periods
- Rotational grazing or cross fencing

Non-Structural Erosion Control

Montana regulates streambed and bank disturbance with two permitting processes. One is the Natural Streambed and Land Preservation Act (310 Permit), which is required of private entities that want to undertake work that would modify the bed or immediate banks of perennial streams, and is administered by local conservation districts. The second is the Stream Protection Act (124 Permit), which applies to state and federal agencies and county and city governments and is administered by the Montana Department of Fish, Wildlife, and Parks.

In addition, federal 404 permits, administered by the U.S. Army Corps of Engineers, are required for activities along navigable waters. The U.S. Fish and Wildlife Service and the Environmental Protection Agency are also involved in this process. The goal of these permit programs is to minimize adverse effects on shoreline and in-stream resources from human activities.

Installation of hardened erosion control structures can negatively affect long-term river function. Complete arrest of bank erosion eliminates the rejuvenating processes of channel migration. Although streambank erosion control structures can reduce localized sediment sourcing through bank erosion, their long-term impacts on overall channel function makes them undesirable management options. Channel migration is necessary for large woody debris recruitment that provides critical components of channel complexity and associated habitat elements such as pools, resting areas, and cover. This restoration strategy focuses on management practices that facilitate natural reinforcement of channel banks by riparian vegetation. The restoration plan encourages CDs, counties, and local planning boards to promote:

- Non-structural erosion control except to protect existing road and bridge infrastructure at risk, and even then mitigating for down stream impacts
- Riparian buffers and revegetation of degraded areas
- Case-by-case review of bank erosion problems and landowner education regarding non-structural erosion control solutions

8.4.6 Other Watershed Management Issues

This section includes a discussion of issues that are not currently primary limiting factors to water quality, but are a consideration for long-term watershed management and restoration. All of the previous and following management issues are interrelated; therefore, a long-term holistic approach to watershed management will provide the most effective results.

Timber Harvest

Beyond associated forest roads and culverts, which were addressed above, timber harvest currently is not significantly affecting water quality in the St. Regis TPA. Future harvest activities must follow published Forestry BMPs (MT Dept of State Lands, 1994; MSU Extension Service, 2001).

Invasive Weeds

Invasive weeds are a growing concern in the St. Regis TPA and most areas of Montana.

Developing an integrated weed management plan is recommended to address noxious weeds across land ownership boundaries. This can be accomplished through the establishment of a Weed Management Area (distinguishable areas based on similar geography, weed problems, climate, and human use patterns), which can provide a channel of communication among landowners and a conduit for funding sources (Duncan, 2001). NRCS and County Weed Management Specialists can provide information about weed management BMPs.

Fish Passage

Twelve culverts were assessed for their ability to allow fish passage under the interstate. Best professional judgment was used to determine if a culvert was a potential barrier to fish passage. This was based on the length and slope of the culvert, and whether there was a drop at the outlet. Nine culverts were assessed on tributaries and three on the mainstem of the St. Regis River. Culverts running under Interstate 90 were assessed on Twelvemile, Twin, Savenac, and Randolph Creeks along with the St. Regis River. Frontage Road crossings over Twin Creek and Savenac Creek were also assessed, along with several other tributary crossings.

The majority of culverts associated with Interstate 90 and Frontage Road were large diameter, with low gradients and deep water in the bottom that did not appear to present any fish passage problems at low flows. Most of the surveyed culverts were corrugated metal pipes (CMP), though two concrete box culverts and a concrete arch culvert were assessed. Culverts under Interstate 90 ranged from approximately 125 to 300 feet long. These culverts may present problems at high flows due to their substantial lengths. The culvert on the St. Regis River mainstem at river station 185,000 was a fish barrier. This culvert, which was on Forest Service land, was an aging concrete arch with a three foot drop at the outlet. The culverts under Interstate 90 at river stations 178,500 and 187,000 may present fish passage barriers, especially at higher flows. The culvert transporting Randolph Creek under Interstate 90 may also be a fish passage barrier. The culvert on Silver Creek was not assessed, though it has been affirmed to be a fish passage barrier. The USFS has also assessed fish passage for many of their culvert crossings and has an inventory of culverts that are likely barriers to fish. Each fish barrier should be assessed individually to determine if it functions as a invasive species and/or native species barrier. These two functions should be weighed against each other to determine if each culvert acting as fish passage barrier should be mitigated.

Fish passage barrier restoration strategies include:

- Locate and perform fish passage assessments on additional road crossings over stream segments where maintaining fish passage if a priority
- Develop a priority list of barrier culverts for replacement
- Conduct culvert replacement in consultation with LNF and FWP biologist to ensure protection of native trout genetics

8.5 Other Restoration Considerations

- MDT should partner in restoration projects within the watershed to mitigate for irretrievable transportation impacts on the St. Regis River.

- The fishery in lower 12 mile creek could benefit if the stream was restored back into its old channel in a portion of the stream that was moved due to road installation. Sediment sources would be mitigated along with fishery habitat because all of the identified eroding banks and mass wasting sources in the Twelvemile Creek Watershed are in the section of the stream that was historically moved.
- The Little Joe road upgrade should not further impact Little Joe Creek's channel constriction. Appropriate BMPs including catchments basins and other sediment trapping BMPs for road sanding need to be considered during design and use if the Little Joe road is paved. An existing/future sediment yield analysis should occur prior to construction to determine if paving the road will increase sediment yields. If the sediment yield is increased a DEQ approved watershed mitigation strategy (ie. addressing other current sediment sources for reduction) should be included in the construction plan.
- The State of Montana will not consider SMZ law waivers without consulting with DEQ and considering DEQ's comments.
- Future home/cabin site development should consider building locations that will not confine stream channel movement, consider leaving shade producing vegetation along stream corridors, and if stream crossings are needed – design culverts/bridges to 100 year storm events. A county planning or zoning and a local landowner outreach program could be an effective tool to address private land sediment and temperature impacts.

SECTION 9.0
MONITORING STRATEGY AND ADAPTIVE MANAGEMENT

9.1 Introduction

This section provides a monitoring strategy to strengthen the TMDLs presented in this report and to help meet the following objectives:
Document progress of future implementation and restoration efforts
Monitor progress toward meeting water quality targets and supplemental indicators
Improve our understanding of appropriate reference conditions for the St. Regis TPA
Conduct an adaptive management strategy to fulfill requirements of the TMDLs

This monitoring plan will evaluate the progress toward meeting or protecting water quality standards and associated beneficial uses (Montana State Law (75-5-703(7) and (9)). The monitoring will also address the tracking of specific implementation efforts. Funding for future monitoring is uncertain and variable due to economic and political change. Prioritization of monitoring activities depends on stakeholder priorities for restoration activities, future land use activities, and funding opportunities.

9.2 Implementation and Restoration monitoring

As defined by Montana State Law (75-5-703(9), the DEQ is required to evaluate progress toward meeting TMDL goals and satisfying water quality standards associated beneficial use support. If this evaluation demonstrates that water quality standards and beneficial use support have not been achieved, then DEQ is required to conduct a formal evaluation of progress in restoring water quality and the status of reasonable land, soil, and water conservations practice implementation to determine if:

- The implementation of a new or improved phase of voluntary reasonable land, soil, and water conservation practices is necessary
- Water quality is improving, but more time is needed for compliance with water quality standards
- Revisions to the TMDL are necessary to achieve applicable water quality standards and full support of beneficial uses

Although DEQ is responsible for TMDL-related monitoring, it is envisioned that much of it could occur under coordination with land managers and local interests. Implementation and restoration monitoring may include summaries of such items as the length of road upgraded to BMP standards, length of decommissioned roads, fish passage barriers corrected, or tracking riparian shade disturbances, as well as the estimated impact of these actions in terms of decreased pollutant loading or improved habitat. Specific details of the implementation and restoration monitoring will be coordinated with local stakeholders and DEQ before future restoration activities occur. To ensure that TMDL implementation is effective in achieving full support of beneficial uses, this monitoring should be closely tied to target and indicator trend monitoring which is discussed in more detail below.

9.3 Monitoring Progress Towards Meeting Targets and Supplemental Indicators

Implementation of the restoration strategy and the continued and refined application of reasonable land, soil, and water conservation practices are expected to decrease pollutant loading to streams in the St. Regis TPA and, over time, to ensure that TMDL targets and Montana water quality standards are met, eventually resulting in full support of beneficial uses. The monitoring described in this section is intended to track progress in meeting those goals, thus closely linked to the implementation and restoration monitoring described previously.

Fine sediment and RSI Targets
Annual monitoring of trends in surface fines, and riffle stability indices should occur after significant restoration efforts are implemented throughout the listed watersheds. Information generated from this monitoring will be used in future evaluation of TMDL target attainment. Particle size distributions will be assessed using McNeil core samples, spawning area grid tosses, and Wolman pebble counts. DEQ will work with all stakeholders on monitoring methods and protocols as necessary. Information generated from this monitoring will be used in future evaluation of TMDL target attainment.

Pools/mile, LWD/mile, Sinuosity, PFC, and Width/Depth Ratios
These target and supplemental indicators measures will be monitored at after significant restoration efforts are implemented at established monitoring locations in each of the listed streams.

Macroinvertebrate and Other Biological Data
Macroinvertebrate samples will be collected after significant restoration efforts are implemented as a measure of aquatic life beneficial use support. As funding permits, periphyton samples will also be collected as an additional measure of biological use support. DEQ will also coordinate with FWP and the Lolo National Forest to continue long-term fish population monitoring, to document trends in juvenile bull trout and westslope cutthroat trout populations as well as numbers of spawning redds.

Anthropogenic Sediment Sources
The reduction of all preventable and significant anthropogenic sediment sources is a primary goal of this document. Accordingly, the TMDL Implementation Team will conduct 5-year inventories of these sources and will track progress towards meeting this goal.

Temperature
Continuously recording temperature monitoring devises provide and simple and cost effective way to gather a large quantity of temperature data, and they have already been used by DEQ, LNF, and other organizations to established a significant temperature monitoring network in the St. Regis TPA. A limited temperature monitoring network should be maintained annually. After significant changes in stream canopy via restorative management, a more robust network should assess conditions over a one year timeframe.

9.4 Reference Monitoring

Continued monitoring of the target/indicator parameters in reference streams is needed to help increase confidence that the TMDL targets and supplemental indicator values that best represent the narrative water quality standards.

DEQ uses the reference condition for parameters that have a continuously progressing negative impact to uses to determine if narrative water quality standards are being achieved. The term “reference condition” is defined as the condition of a waterbody capable of supporting its present and future beneficial uses when all reasonable land, soil, and water conservation practices have been applied. In other words, reference condition reflects a waterbody’s greatest potential for water quality given historic land use activities. DEQ applies the reference condition approach for making beneficial use-support determinations for certain pollutants (such as sediment) that have specific narrative standards.

Waterbodies used to determine reference condition are not necessarily pristine or perfectly suited to giving the best possible support to all possible beneficial uses. Reference condition also does not reflect an effort to turn the clock back to conditions that may have existed before human settlement, but is intended to accommodate natural variations in biological communities, water chemistry, etc. due to climate, bedrock, soils, hydrology and other natural physiochemical differences. The intention is to differentiate between natural conditions and widespread or significant alterations of biology, chemistry, or hydrogeomorphology due to human activity. Therefore, reference conditions should reflect minimum impacts from human activities and represent the potential conditions that could be attained (given historical land use) by the application of reasonable land, soil, and water conservation practices. DEQ realizes that pre-settlement water quality conditions usually are not attainable.

The following methods may be used to determine reference conditions:

Primary Approach

- Comparing conditions in a waterbody to baseline data from minimally impaired waterbodies that are in a nearby watershed or in the same region having similar geology, hydrology, morphology, and/or riparian habitat
- Evaluating historical data relating to condition of the waterbody in the past
- Comparing conditions in a waterbody to conditions in another portion of the same waterbody, such as an unimpaired segment of the same stream

Secondary Approach

- Reviewing literature (e.g. a review of studies of fish populations, etc. that were conducted on similar waterbodies that are least impaired)
- Seeking expert opinion (e.g. expert opinion from a regional fisheries biologist who has a good understanding of the waterbody’s fisheries health or potential)
- Applying quantitative modeling (e.g. applying sediment transport models to determine how much sediment is entering a stream based on land use information etc.)

DEQ uses the primary approach for determining reference condition if adequate regional reference data are available and uses the secondary approach to estimate reference condition when there are no regional data. DEQ often uses more than one approach to determine reference condition, especially when regional reference condition data are sparse or nonexistent.

9.5 Adaptive Management Strategy

As monitoring data is obtained and evaluated, DEQ in partnership with the stakeholders will adjust load allocations as necessary to meet targets, especially those targets associated with in-stream conditions. Additionally, targets could also be adjusted. These adjustments would take into account new information as it arises.

The adaptive management strategy is outlined below:

- TMDLs and Allocations: The analysis presented in this document assumes that the load reductions proposed for each of the listed streams will enable the streams to meet target condition and further assumes that meeting target conditions will ensure full support of all beneficial uses. Much of the monitoring proposed in this section of the document is intended to validate this assumption. If it looks like greater reductions in loading or improved performance is necessary to meet targets, then updated TMDL and/or allocations will be developed based on achievable reductions via application of reasonable land, soil, and water conservations practices.
- Impairment Status: As restoration activities are conducted in the St. Regis TPA and target and supplemental indicator variables move towards reference conditions, the impairment status of the listed waterbodies would be expected to change. An assessment of the impairment status will occur after significant restoration occurs in the watershed.

10.0 PUBLIC PARTICIPATION AND INVOLVEMENT

This section will be updated after the public comment period. An additional appendix with response to public comments will be provided in the final version of this document. Sections of the document will likely be edited due to public comments.

Public and stakeholder involvement is a component of water quality restoration planning and TMDL development. This involvement is supported by U.S. EPA guidelines, the Federal Clean Water Act, and Montana State Law. Public and stakeholder involvement is desirable to ensure development of high quality, feasible plans and to increase public acceptance. Stakeholders including the Mineral County Conservation District, the Lolo National Forest, Montana Fish Wildlife and Parks, Montana Department of Transportation, and Montana Department of Natural Resources and Conservation have been involved with technical support, interim product reviews, and public outreach components of the plan. Also, this group of stakeholders was given the opportunity to comment on portions of the draft document.

An important opportunity for public involvement was the 30-day public comment period. This public review period was initiated on XXX and extended to XXX. A public meeting on X in X, Montana, provided an overview of the TMDLs for the St. Regis River Watershed and an opportunity to solicit public input and comments on the plan. This meeting and the opportunity to provide public comment on the draft document were advertised via a press release by DEQ and was included in a number of local newspapers. Copies of the main document were available at the St. Regis and Superior City Libraries and via the internet on DEQ's web page or via direct communication with the DEQ project manager.

Through the public comment process, significant comment was received by X different individuals, groups, agencies, or other entities. **Appendix X** includes a summary of the public comments received and the DEQ response to these comments. As noted in the introduction of **Appendix X**, many of the comments led to significant modifications captured within the final version of the this plan. The original comment letters are located in the project files at DEQ and may be reviewed upon request.

DEQ also provides an opportunity for public comment during the biennial review of the Montana's Integrated Water Quality Report that includes the 303(d) List. This includes public meetings and opportunities to submit comments either electronically or through traditional mail. DEQ announces the public comment opportunities through several media including press releases and the Internet.

SECTION 11.0 LITERATURE CITED

Alvord, William, and Peters, John, C. 1963. Channel Changes in 13 Montana Streams. Fisheries Division, Montana Fish and Game Commission. Helena, Montana.

Bahls, Loren L. 2002. Periphyton Bioassessments for Saint Regis River Tributaries. Montana Department of Environmental Quality. Helena, Montana.

Belt, George H.; O'Laughlin, Jay; and Merrill, Troy. 1992. Design of Forest Riparian Buffer Strips for the Protection of Water Quality: Analysis of Scientific Literature. Idaho Forest, Wildlife, and Range Policy Analysis Group, Report No.8. Idaho Forest, Wildlife, and Range Experiment Station, University of Idaho. Moscow, Idaho.

Berg, Rodney K. 1989. Statewide Fishery Report: Survey and Inventory of Coldwater Streams, Lower Clark Fork [Clark Fork / Blackfoot] River Fishery Investigation. July 1, 1988 – June 30, 1989. Montana Fish, Wildlife, and Parks. Helena, Montana

Beschta, Robert L., and W.S. Platts 1986. Morphological Features of Small Streams: Significance and Function. *Water Resources Bulletin* 22(3):369-379.

U.S. Department of the Interior, Bureau of Land Management ; U.S. Department of Agriculture, Forest Service ; Natural Resources Conservation Service. 1999. Riparian Area Management: A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lentic Areas United States Department of the Interior, Bureau of Land Management. Washington D.C. Technical Reference 1737-15.

Bollman, Wease. 2001. An Analysis of Aquatic Invertebrates and Habitat of Streams in the St. Regis River Watershed, November 2001.

Bollman, Wease. 2004. Presentation at the Western Montana Sediment Target Workshop, April 28 and 29, 2004, Missoula, Montana.

Bonneau, Joseph L., and D.L. Scarnecchia. 1996. Distribution of Juvenile Bull Trout in a Thermal Gradient of a Plunge Pool in Granite Creek, Idaho. *Transactions of the American Fisheries Society* 125(4):628-630.

Buchanan, D.V., and S.V. Gregory. 1997. Development of water temperature standards to protect and restore habitat for bull trout and other cold water species in Oregon. In W.C. Mackay, M.K. Brewin, and M. Monita, eds. Friends of the Bull Trout Conference Proceedings. P8.

Bunte, K., and S.R. Abt. 2001 Sampling Surface and Subsurface Particle-Size Distributions in Wadable Gravel- and Cobble-Bed Streams for Analyses in Sediment Transport, Hydraulics, and Streambed Monitoring. United States Department of Agriculture, Forest Service, Rocky Mountain Research Station. General Technical Report RMRS-GTR-74.

Chapman, Donald W. and K.P., McLeod. 1987. Development of Criteria for Fine Sediment in the Northern Rockies Ecoregion: Final Report. EPA 910/9-87-162. US Environmental Protection Agency, Office of Water. Seattle, WA.

Dunham, J Jason B., B.E. Rieman, and G. Chandler. 2003. Influences of Temperature and Environmental Variables on the Distribution of Bull Trout within Streams at the Southern Margin of Its Range. *North American Journal of Fisheries Management* 23(3):894-904.

Elliot, William J., D.E. Hall, S.R.Graves, and D.L. Scheele. 1999. XDRAIN Cross Drain Spacing – Sediment Yield Program Version 2.000 Technical Documentation. USDA Forest Service, Rocky Mountain Research Station, San Dimas Technology and Development Center. http://forest.moscowfsl.wsu.edu/fswepp/docs/xdrain2doc.html

EPA. 2000. Nutrient Criteria Technical Guidance Manual Rivers and Streams. EPA-822-B-00-002. U.S. Environmental Protection Agency, Office of Water and Office of Science and Technology. Washington D.C.

EPA. 1999. Protocol for developing sediment TMDLs. Office of Water, United States Environmental Protection Agency. Washington D.C. EPA 841-B-99-004.

Federal Highway Administration. 2001. HY 8 - HDS 5 Appendix D Chart Calculator. http://www.fhwa.dot.gov/engineering/hydraulics/software/softwarearchive.cfm

Fraley, John J., and B.B. Shepard. 1989. Life History, Ecology, and Population Status of Migratory Bull Trout (Salvelinus confluentus) in the Flathead Lake and River System, Montana. *Northwest Science* 63(4):133-143.

GT Consulting. 1999. Final Specialist Report, Biological Resources, Fisheries, and Aquatic Sciences. Prepared for USDA Forest Service, Lolo National Forest. Missoula, Montana. March 1999.

Hauer, F. Richard, G.C. Poole, J.T. Gangemi, and C.V. Baxter. 1999. Large woody debris in bull trout (Salvelinus confluentus) spawning stream of logged and wilderness watersheds in northwest Montana. *Canadian Journal of Fisheries and Aquatic Sciences* 56(6):915-924.

HDR Engineering. 2002. Final Report: Water Temperature of the Lochsa River and Selected Tributaries. Prepared for: Idaho Department of Environmental Quality. Prepared by: HDR Engineering, Boise, Idaho.

Hendrickson, Shane, and K Cikanek. 2000. Middle Clark Fork River Section 7 Consultation Watershed Baseline Analysis. US Forest Service, Lolo National Forest. Lolo, Montana. May 2000.

Hostetler, S.W. 1991. Analysis and Modeling of Long-Term Stream Temperatures on the Steamboat Creek Basin, Oregon: Implications for Land Use and Fish Habitat *Water Resources Bulletin* 27(4):637-647.

Howse, Norm. Effect of Highway 90 Location on St. Regis River Aquatic Habitat. USDA USFS Northern Region, Missoula, Montana, November 1969.

Kappesser, Gary B. 2002. A Riffle Stability Index to Evaluate Sediment Loading to Streams. *Journal of the American Water Resources Association* 38(4): 1069-1081.

Knighton, David. 1998. *Fluvial Forms and Processes*. John Wiley and Sons Inc., New York, New York.

Kramer, Richard P., R. Swanson, Y.Vadeboncoeur, and K Furrow. 1991.
Fisheries Habitat and Aquatic Environment Monitoring Report: Lolo and Deerlodge National Forests 1989 and 1990. Deerlodge National Forest and Lolo National Forest.

Land & Water Consulting, Inc. 1996. St. Regis River Restoration: Channel relocation feasibility and design. Prepared for Lolo National Forest. February 12, 1996.

Logan, Robert 2001. Water quality BMPs (best management practices) for Montana forests. Montana State University Extension Service EB158. In cooperation with Montana Department of Natural Resources and Conservation, Forestry Division and the Montana Logging Association. Missoula, Montana.

MacDonald, Lee H., A.W.Smart, and R.C Wissmar. 1991. Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska (Complete) EPA 910/9-91-001. U.S. Environmental Protection Agency. Seattle, Washington.

McHenry, Michael L., D.C. Morrill, and E. Currance. 1994. Spawning Gravel Quality, Watershed Characteristics and Early Life History Survival of Coho Salmon and Steelhead in Five North Olympic Peninsula Watersheds. A study funded by the Washington Department of Ecology Centennial Clean Water Fund and Section 205J Clean Water Act. Fisheries Department Lower Elwha S'Klallam Tribe and Fisheries Management
Makah Tribe.

McPhail, J.D., and C.B. Murray. 1979. *The Early Life-history and Ecology of Dolly Varden (Salvelinus malma) in the upper Arrow Lakes: A report submitted to the B.C. Hydro and Power Authority and Kootenay Region Fish and Wildlife Branch.* University of British Columbia, Department of Zoology and Institute of Animal Resources. Vancouver, B.C.

MDEQ. 2006. 2006 Montana Water Quality Integrated Report. Montana Department of Environmental Quality, Planning, Prevention, and Assistance Division – Water Quality Standards Section. Helena, Montana.
http://deq.mt.gov/CWAIC/wq_reps.aspx?yr=2006qryId=14791.

MDEQ. 2004b. Circular WQB-7: Montana Numeric Water Quality Standards. Montana Department of Environmental Quality, Planning, Prevention, and Assistance Division – Water Quality Standards Section. Helena, Montana. January 2004. Available at: http://www.deq.state.mt.us/wqinfo/Circulars/WQB-7.PDF.

Montana Natural Resource Information System. 2004. Montana Fisheries Information System Database Query. Available at:http://maps2.nris.state.mt.us/scripts/esrimap.dll?name=MFISH&Cmd=INST.

Montgomery, David R., and J.M. Buffington. 1997. Channel-reach morphology in mountain drainage basins. *GSA Bulletin* 109(5):596-611.

Omang, R.J. 1992. Analysis of the Magnitude and Frequency of Floods and the Peak-Flow Gaging Network in Montana. Montana Department of Transportation and U.S. Geological Survey. Water Resources Investigations Report 92-4048. 70pp.

Opheim, Boyd R., et al. 1965. Inventory of Waters of the Project Area July 1, 1963 to June 30, 1964. Western Montana Fisheries Study. Fish Wildlife and Parks report F-12-R-101.

Overton, C. Kerry; Wollrab, Sherry P.; Roberts, Bruce C.; Radko, Michael A. 1997. R1/R4 (Northern/Intermountain Regions) Fish Habitat Standard Inventory Procedures Handbook. United States Department of Agriculture, Forest Service, Intermountain Research Station. Ogden, Utah. General Technical Report INT-GTR-346.

Pfankuch, D. 1973. Vegetation manipulation guidelines for the Lolo National Forest; a revision and updating of the October 1967 procedures. USDA Forest Service. Lolo National Forest. April 1973. 69 p.

Reiser, D.W., and T.C. Bjornn. 1979. Influence of forest and rangeland management on anadramous fish habitat in the Western United States and Canada, 1. Habitat requirements of anadromous salominds. General Technical Report PNW-96. U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. Portland, Oregon.

Riehle, M. D. 1993. Metolius Basin Water Resources Monitoring, Progress Report 1988-1992. U.S.Department of Agriculture, Forest Service, Deschutes National Forest. Bend, Oregon.

Rieman, Bruce E., and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. U.S. Dept. of Agriculture, Forest Service, Intermountain Research Station. Ogden, Utah.

Riggers, Brian W., A. Rosquist, R. Kramer, and M. Bills. 1998. An Analysis of Fish Habitat and Population Conditions in Developed and Undeveloped Watersheds on the Lolo National Forest. USDA Forest Service, Lolo National Forest.

Rollins, A. 2002. Personal Communication with Lolo National Forest Hydrologist, January 28, 2002.

Rosgen, David L. and H.L. Silvey. 1996 Applied River Morphology. Wildland Hydrology. Pagosa Springs, Colorado.

Rosquist, Skip, and T. Sylte. 1998. Watershed Monitoring Report 1997: Lolo National Forest
Rowe, M., D. Essig, and B. Jessup. 2003. Guide to selection of sediment targets for use in Idaho TMDLs. Idaho Department of Environmental Quality and Tetra Tech, Inc. Pocatello, Idaho.

Relyea, Christina D, G. Wayne Minshall, Robert J. Danehy. 2000. Stream Insects as Bioindicators of Fine Sediment. Stream Ecology Center: Dept. of Biological Sciences: Idaho State University, Pocatello, ID

Shepard, Bradley B., and P.J. Graham. 1983. Fish resource monitoring program for the upper Flathead Basin. Flathead Basin Steering Committee for the Flathead River Basin Environmental Impact Study. Sponsored by Environmental Protection Agency Region VIII, Water Division.

Selong, Jason H., T.M. McMahon, A.V. Zale, and F.T Barrows. 2001. Effect of Temperature on Growth and Survival of Bull Trout, with Application of an Improved Method for Determining Thermal Tolerance in Fishes. *Transactions of the American Fisheries Society* 130(6):1026-1037.

Thomas, Ginger. 1992. Status Report: Bull Trout in Montana. Montana Department of Fish Wildlife and Parks. Helena, Montana.

USDA. 1995. Forest Service Manual Title 2600-Wildlife, Fish, and Sensitive Plant Habitat Management. Amendment No. 2600-95-7.

USDA. 1996. Integrated Scientific Assessment for Ecosystem Management in the Interior Columbia Basin and Portions of The Klamath and Great Basins. GTR PNW-GTR-382.

USDA. 2003. Region 1 Fish Passage Evaluation Criteria. Northern Regions, Missoula, MT. 11pp.

USDA. 1976. Forest hydrology: hydrologic effects of vegetation manipulation, Part II. USDA Forest Service.

USDA. 1991. WATSED Water & Sediment Yields. USDA Forest Service Region 1 and Montana Cumulative Watershed Effects Cooperative. Missoula, MT.

USDA. 1995. Two Joe Timber Sales: Draft Environmental Impact Statement. U.S. Department of Agriculture, Forest Service, Lolo National Forest, Lolo National Forest Superior Ranger District. Superior, Montana.

U.S. Fish and Wildlife Service. 1998. A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Watershed Scale.

U.S. Fish and Wildlife Service. 1999. Determination of threatened status for bull trout in the coterminous United States. *Federal Register* 64(210):58910-58933.

USDA Forest Service. 1999. Forest Plan Monitoring and Evaluation Report. U.S. Department of Agriculture, Forest Service, Lolo National Forest, Lolo National Forest.Missoula, MT.

Washington Forest Practices Board. 1997. Washington Forest Practices Board Manual: Standard Methodology for Conducting Watershed Analysis Under Chapter 222-22 WAC.

Wasniewski, Louis W. 1994. Hillslope sediment routing below new forest roads in Central Idaho. Oregon State University. Corvallis, Oregon. MS Thesis. 105 p.

Weaver, Thomas M. and R.G. White. 1985. Coal Creek Fisheries Monitoring Study No. III. Quarterly Progress Report. USDA Forest Service, Montana State Cooperative Fisheries Research Unit, Bozeman, MT. 94 p.

Weaver, Thomas M. and J.J. Fraley. 1991. Fisheries habitat and fish populations. Flathead Basin Forest Practices Water Quality and Fisheries Cooperative. Flathead Basin Commission. Kalispell, Montana.

Weaver, Thomas M. and J.J. Fraley. 1993. A Method to Measure Emergence Success of Westslope Cutthroat Trout Fry from Varying Substrate Compositions in a Natural Stream Channel. North American Journal of Fisheries Management 13(4):817-822.